Contributions to Management Science

Umit Hacioglu *Editor*

Digital Business Strategies in Blockchain Ecosystems

Transformational Design and Future of Global Business

Springer

Contributions to Management Science

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Umit Hacioglu
Editor

Digital Business Strategies in Blockchain Ecosystems

Transformational Design and Future of Global Business

Springer

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Foreword

Blockchain and related technologies have begun to attract the attention of scholars and professionals worldwide. Academic journals and publications, however, failed to cover different aspects of this newly evolving and ever-growing field. This edited compilation containing 30 works by selected authors from countries ranging from India to Korea would be a pioneer work to fill the void that exists currently between blockchain practice and academic research. The volume not only includes contributions from eminent universities around the globe but also includes contributions by professionals from the banking sector. The research studies presented in the book are mainly concentrated in blockchain applications in finance and logistics, but novel and interesting applications such as humanitarian logistics (one example being the blood distribution problem) are also represented.

The volume is divided into four main sections along with the headlines of business model design, the digital transformation of business, digital business strategies, and accounting applications. Five chapters in the first section mainly point out the importance of blockchain applications as they relate to business model design in the digital era. The first chapter highlights the importance of artificial intelligence (AI) and robotic process automation (RPA), especially for the financial services sector. This chapter is a contribution by members of the largest public bank in Turkey. The section goes on to illustrate issues in human–robot interaction, the Internet of Things (IoT), and culture as a key player in the success of digital transformation.

The second section is concerned with the digital transformation of business operations in the blockchain ecosystem. This section dedicates three chapters to the applications of blockchain in the logistics and supply chain management areas. Logistics involves the transfer of goods from suppliers to the final consumers along with many different transport modes. The correct matching of the shipping lists of the sources of origin and the demand points may be critical and difficult to ascertain using the traditional systems. Blockchain here may be a critical player in this industry. The human resources management (HRM) area is also demonstrated here as a potential area for the application of blockchain technologies.

The third section is about digital business strategies and competencies and starts with a paper discussing the key success factors for strategic management in digital business. Apart from chapters presenting an exhaustive treatment of business strategy in the IT field, the section also includes a practical case study from the maritime industry and a practically oriented treatise of setting structure and strategy for a virtual travel organization.

The next section explores the issues surrounding accounting applications in the blockchain ecosystem. The final section presents the negative side of the possible misuse of the technology citing examples from copyright protection and cybercrime.

All in all the book covers a wide range of topics relating to the newly evolving field and would shed light on different aspects that a typical practitioner or academic can wish to explore further. Moreover, the collection of articles does display theoretical contributions to the literature as well as practical case studies from diverse sectors that blockchain could possibly be used in. It is therefore a commendable effort by the editors to put together such a volume and make it available to the researchers in the international arena.

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July 2019

Preface

The newest technologies in blockchain environment have been transforming traditional business operations significantly in the last several years. Blockchain technologies are referred to as the decentralized integration of computers and distributed networks that are linked together safely based on the new growing list of records, so-called blocks, connecting the world to the future of business without regulation of any central authority. Adopting this new technology is a challenging issue for many strategists and managers. It is now time to make a fresh start to understand how the blockchain ecosystem works and shapes the existing business operations in the digital age. Moreover, it is also clear that managerial action is a necessity for coping with this new digital transformational change by adopting new business strategies and philosophies. In a business ecosystem, managing this transformational change is a significant pattern of concern for strategic thinking in front of many pioneering companies in different industries from aviation to communications.

In the existing literature, the latest developments and researches spotlighted the importance of the *blockchain ecosystem* which enhances the business performance in volatile conditions. Traditional studies in the past heavily concentrated on the organization-based or market-based factors mostly related to the side of human resources, leadership, robotic technologies, financial decision making, culture, optimization, and so on. Recently, the newest studies on digital business operations highlighted the importance of blockchain ecosystem components and their role in implementing competitive digital business strategies to maximize operational efficiency.

In the blockchain ecosystem, some important topics shaping business strategy-based studies include data security with quantum cryptography, value transfer via smart contracts, increased efficiency, sustainable optimal performance, and development of a smart solution. In addition to them, big data, neural networks, and artificial intelligence are today linked to blockchain studies. Although blockchain is still a new topic today for many researchers and strategists, they are seeking true answers and trying to locate a new approach to strategic thinking and structural design too.

In the existing literature, several studies highlighted that (1) there is a significant correlation between enhanced business performance and cybersecurity, (2) operational costs in transportation are decreased with the integration of blockchain systems, (3) effective communication through supply channels via data transfer systems embedded in blockchain ecosystem decreases delays in transportation process, and (4) blockchain ecosystem has positive effects on a firm's performance while optimizing production means via secured networks.

For many digital business enterprises, owners today also question the benefits of building enterprise-level blockchain applications which may have a broader impact on markets while they are costly investments in the short run. Investors are still confused about the benefits of adopting this new technology in business operations. Decision makers also still need answers on future business performance issues related to blockchain-based business strategies.

To which extent are these hot topics in the blockchain ecosystem successfully entitled to this digital transformational change? Are they capable of enhancing business performance? Could effective digital business strategies and firm performance be easily linked together within a blockchain ecosystem? New digital business strategies in the blockchain ecosystem will spotlight important clues for some questions too: Will it be possible to adopt traditional business strategies to a new digital era via the blockchain ecosystem? Will artificial intelligence really decide on the level of financial leverages or maximize the firm performance and value while determining WACC parameters? Will social media strategies be embedded in digital marketing activities with cluster learning? The authors of the chapters in this publication have contributed to the success of this book by the inclusion of their respective studies answering most of these questions.

This novel book emphasizes on the digital business strategies in blockchain ecosystems and transformational change coping with challenges in the digital era. It is anticipated to be one of the pioneering premier sources in this field with the contribution of scholars and researchers from different disciplines overseas. Contributors in this study formulated the new insights on the transforming process of business functions and the applications of digital business strategies in the business ecosystem via blockchain technologies. Our contributors to this study formulated the new competitive strategies for digital business in this new age. Thanks to interdisciplinary participation between world-class scholars with respect to their studies, it is now possible to mention that this book contributes in the development process of company strategic roadmap and provides a strategic toolkit for decision makers in business entities.

This book is composed of five contributory sections with 30 chapters. The first section outlines *the business model design in the digital era* within the blockchain ecosystem. Chapters in this section spotlighted the functionality of the blockchain ecosystem and the transformation of business. This book continues with section two outlining "Digital Transformation of Business Operations in the Blockchain Ecosystem." Chapters in this section assessed the digital transformation process of business functions and operations. The third section builds on the "Digital Business Strategies and Competencies." Chapters in this section determine key success factors for strategic management and underline the evolution of digital business strategies with the adoption of blockchain technologies. Chapters in this section also develop strategic thinking for digital business and develop insights for digital business strategies for strategic entrepreneurship. The next section concentrates on the transformation of *accounting applications in the blockchain ecosystem* in the digital era. Chapters in this section develop a critical approach to the evolving role of accounting within the blockchain ecosystem. Finally, the ending section, "Cybercrime, Legal Aspects, and Relevant Topics," assesses relevant topics in digital business and blockchain technologies including cybersecurity, legal and social aspects, and future directions on blockchain-based studies.

Chapter 1 evaluates the transformation of the business model in the finance sector with artificial intelligence and robotic process automation. Dr. Met and his colleagues advocate that automation and data are driving fundamental changes in our daily lives and in the way of doing business. They evaluated that how financial institutions should change their business models in order to benefit from these two developments and a use case of a bank has been shared.

Chapter 2 features human–robot interaction in organizations. Dr. Tunc's study aims to explore how the interaction between humans and robots affects the workplace and in what aspects we can explain the nature of sociality and collaboration with robots. It also aims to put forward the advantages and disadvantages of human–robot interaction by presenting essential reference points and discussing many aspects of human–robot interaction in organizations.

Chapter 3 assesses the future of the Internet of Things in the blockchain ecosystem from organizational and business management perspectives. Dr. Zehir and Dr. Zehir focus on the Internet of Things (IoT) in blockchain ecosystems stating that IoT is a technological paradigm that bridges physical and digital worlds over a global network. They also highlight that there are a number of major challenges such as privacy and security. Blockchain can be a solution to these problems.

Chapter 4 introduces a blockchain-based framework for blood distribution. Dr. Cagliyangil and his colleagues propose such an Ethereum blockchain-based framework called KanCoin concerning this potential in order to manage and adjust the processes for efficient distribution planning in the blood delivery system from donors to distribution centers and patients at medical centers in a more effective way than the conventional procedures.

Chapter 5 develops an institutional view on developing a supportive culture in digital transformation. Dr. Gurkan and Dr. Ciftci state that organizations create a digital culture by adapting their culture to the new format in order to be successful during this challenging process. Culture is the most important element for the continuation of the core values and the participation of the employees with the least resistance. Thus, their study examines the effect of digital transformation and culture on this transformation process. Information is also provided about the digital organizational culture.

Chapter 6 develops an institutional approach to the digitalization of business functions under Industry 4.0. Dr. Cagle and her colleagues aim to highlight the role of each function within Industry 4.0. Moreover, the chapter will determine the actualized benefit of transitioning toward Industry 4.0, separate from the recognized benefits under the literature.

Chapter 7 assesses a new marketing trend in the digital age with social media marketing. Dr. Sumer states that consumers can influence each other's preferences through comments that they share over social media. Their comments on social media are important in the promotion of goods and services. Therefore, it would not be wrong to say that social media is an effective marketing tool in today's business environment. This chapter is aimed at examining the concept of social media marketing and its effects on the marketing activities of businesses.

Chapter 8 develops a critical approach to the transformation of supply chain activities in the blockchain environment. In this chapter, the potential impact of the blockchain technology on supply chain management (SCM) was investigated to reveal the nature of transformation that it can result in the domain by Drs. Akyuz and Gursoy. Findings reveal that technology is expected to provide accurate and trustable transaction infrastructure as well as true visibility and traceability across partners. With its potential to provide a transparent and trustable multi-partner ecosystem, it appears that blockchain will accelerate and strengthen the realization of a collaborative, IT-based network paradigm. Hence, findings of the study support that the blockchain technology will be a critical enabler of the transformation of the supply chains into tightly coupled, transparent collaborative ecosystems.

Chapter 9 initially assesses the digitalization process in logistics operations and Industry 4.0 and develops an understanding of the linkages with buzzwords. Dr. Sorkun's study aims to initially introduce the Industry 4.0 enabling technologies (buzzwords), expected to be widely used in logistics operations in the immediate future, and then reveals the linkages between these technologies. To this end, this study applies the fuzzy-total interpretative structure modeling on the Industry 4.0 enabling technologies, which are big data analytics, Internet of Things, artificial intelligence, cloud technology, 3D printing, augmented reality, 5G connection, and autonomous vehicles. The results show that most Industry 4.0 enabling technologies are interdependent but to different degrees. These results provide guidance on which technologies firms should primarily focus on to achieve digital transformation in logistics operations.

Chapter 10 draws attention to the future directions of the digitalization of business logistics activities. Drs. Bayarcelik and Bumin Doyduk stated that Industry 4.0 enables communication between humans and machines in cyber-physical systems (CPS). The concept of Industry 4.0 was first brought up in Germany. With the promises of the concept and increasing demand in cost-effectiveness, flexibility, and sustainability, Industry 4.0 has drawn considerable interest globally. The Industry 4.0 era will lead to breakthrough chances in the business world. As the technologies of this era enable ubiquitous presence and real-time information about every single piece of a process, it has been used in many firms in developed countries for some time.

Chapter 11 develops a critical approach to the digital transformation of human resources management with an assessment of the digital applications and strategic tools in HRM. Dr. Vardarlier indicates that enterprises now use digital human resources systems while carrying out their human resources functions. In this respect, while enterprises offer many innovations in the digital field to consumers, human resources management also applies similar innovations to employees or candidates. Therefore, digital transformation in human resources processes is more effective when used as part of a broader employment process. In this context, this study focuses on the use of digital applications in the human resources management of enterprises. However, the reflections of digitization on human resources processes have also been elaborated.

Chapter 12 analyzes the transformation of human resources management and its impact on overall business performance using big data analytics and AI technologies in strategic HRM. Prof. Zehir and his colleagues demonstrate that digitization in the workplace has already affected working methods and the working environment. The digital transformation of human resources management (HRM) is one of the most discussed topics in recent academic studies. In that context, this chapter investigates the transformation of strategic HRM by big data and artificial intelligence (AI) technologies and the impact on business performance. The authors discussed the impact of digital technologies on SHRM and how big data and AI technologies enhance the strategic development of HR. Secondly, the role of technology in HR evolution from 1945 to the present is explored. It can be seen that as technology develops, the business also changes the way it manages human resources. Third, the importance of the use of big data and AI technologies in HR functions is discussed. Finally, the ways in which HR contributes to business performance as a result of the digital transformation of HR are discussed. Suggestions and future directions are provided for both HR professionals and researchers to support overall business performance by transforming SHRM into digital SHRM.

Chapter 13 initially determines key success factors for strategic management in digital business. Dr. Met and his colleagues indicate that technology improves quickly and every object that comes into direct contact with life is being digitized. The developments in the field of information technologies and the need for digital transformation have led to a rapid change in the traditional ways of doing business. Both the biggest threat and opportunity come from technology. It can bring on fail for the companies that don't understand the technological developments correctly and adapt to the changing environment. It has become an important issue to create the right strategic management model in order to enable firms to evaluate the opportunities and minimize risk during digital transformation because every enterprise has a different approach to digitalization.

Chapter 14 explains the platform strategy for business transformation in a blockchain ecosystem. Prof. Ku's chapter explains blockchain platform strategies for business transformation in a blockchain ecosystem. The blockchain platform, which includes specific transaction records and distributed ledgers for certain time periods, can be defined as (1) a core asset in a blockchain ecosystem, (2) a common basic asset, (3) an asset possibly generating derivative content and services, such as complements, (4) the hub in the value chain in blockchain technology-based businesses, and (5) an asset retaining blockchain technology.

Chapter 15 demonstrates the practical evidence of blending business strategies with IT in the digital era. Dr. Met and his colleagues clearly state that the alignment of IT management and business is the key factor for the success of enterprises. The IT management must take care and understand the business strategies and proceed in this context for the management of data, application, and infrastructure architecture. The business must also implement methods to transfer the logic behind the strategies, vision, organization, the processes to improve, and the functions to develop to the IT management in the context of business architecture. Throughout blending business strategies with IT management, the enterprises can achieve more efficient business and IT operations, better return, reduced risk, and complexity; so, the organization becomes more agile among different distribution channels, project and change management is easier, and the software development costs will be lower.

Chapter 16 focuses on the recent developments of artificial intelligence in business logistics: a maritime industry case. Dr. Ceyhun highlights that fast-growing technological features of today drive all companies in all sectors to mechanization with automation by artificial intelligence (AI). As the maritime and logistics sector moves toward becoming fully digital, AI becomes a significant competition element for leading shipping companies in business logistics and maritime nations. Although the use of artificial intelligence requires a great investment in the short term, it brings profitability by reducing the costs in the long term.

Chapter 17 investigates on the use of artificial intelligence as a business strategy in the recruitment process and social perspective. The authors aim to reveal the benefits and risks of AI-based use on human and community in recruitment processes in the human resources department. The applications of artificial intelligence are explained with examples.

Chapter 18 highlights the importance of digital marketing strategies and business trends in emerging industries. Authors state that there are several difficulties an emerging industry faces while entering into a market such as high costs, uncertainty, complexity, and instability. Traditional marketing may not be effective enough in these industries to deal with these difficulties due to the ongoing transformation in the technology and digital marketing. This is expected to present more useful and effective results. Therefore, digital marketing potential in emerging industries will be presented in this study.

Chapter 19 explains the framework of the structure and strategy in virtual organizations and develops insights on the strategies for virtual travel organizations. Drs. Toylan and Cakirel address the network-based strategies of virtual travel organizations, which are in conformity with today’s management mentality. In this sense, the concept of virtual organization has been defined in terms of the travel sector in particular. After referring to the concept of virtual travel organization, the structure, process, and characteristics are discussed. In conclusion, several strategy suggestions have been made for virtual organizations. The literature does not include many studies explaining the strategies on the basis of networks and exhibiting the components that affect the performance of VTO. The study contributes to the literature in those aspects and can also be a significant source of information for field students, scholars, and professionals.

Chapter 20 develops a futuristic view of the effects of blockchain technology on accounting applications. This chapter aims to exhibit the current accounting operation areas that blockchain technology impacts, as well as the future direction of the integration between technology and accounting.

Chapter 21 develops a critical approach to accounting in the digital era with the assessment of the impacts of Industry 4.0 on financials. The chapter focuses on the effects of Industry 4.0 on financial statements and financial statement analysis from a theoretical perspective. The possible effects of developing information technologies on financial statements and ratio analysis will be discussed.

Chapter 22 answers on the question of how to use blockchain effectively in auditing and assurance services. This chapter will explain how and when to use blockchain technologies and identify the potential new risks that await the auditor. Since no definitive rules and regulations have yet been made, this study is based on the opinions of several professional bodies that are currently tackling Bitcoin and other sub-tools that blockchain ecosystems are offering.

Chapter 23 takes a contrary view and discusses reflections of digitalization on accounting: the effects of Industry 4.0 on financial statements and financial ratios. This chapter aims to provide an assessment of the implementation outcome of the digitalization process and provides an in-depth understanding of the financial impact of Industry 4.0.

Chapter 24 examines the position of dark factories from an Industry 4.0 perspective with its effects on cost accounting and managerial accounting. The aim of the study was to investigate the Industry 4.0 effects on cost and management accounting. Within the scope of this study, the roles of cost and management accounting in dark factories, which have the potential to become the production business of the future, were discussed. This study suggested that the existing accounting perspective should be changed. As a result of completed studies, various suggestions in accordance with Industry 4.0 have been put forward to reduce human error and wastage, better manage time, increase production capacity and quality, reduce costs, and provide a competitive advantage.

Chapter 25 evaluates the cybercrime economy via MCDM and decision tree approaches with the case of Zonguldak. This study aims to evaluate the relations/determiners of CA damages and information technology (IT) investments to firms' economics and present the findings to the researchers/decision makers.

Chapter 26 draws a comprehensive framework of copyright and intellectual property in digital business with the issue of protection and retrieval of investment in intellectual creation. The aim of this chapter will be to explicate about copyright in digital business. The study begins with highlighting the overview of copyright law and digital business scenario. The chapter further scrutinizes the issues and challenges associated with the copyright in digital business.

Chapter 27 draws attention on the state of the art in blockchain research (2013–2018) with the scientometrics of the related papers in Web of Science and Scopus. The objective of this chapter is to present the current trends, statistics, and relationships from the growing body of literature on blockchain technology. This research is supported by scientometrics, which is the methodology used to analyze data extracted from online scientific databases to obtain the major trends, research agendas, demographics, particular metrics, and networks and understand leading topics. This research is based on papers published in the Web of Science (WoS) and Scopus databases between 2013 and 2018. The intent of this research is to shed light on the holistic view of blockchain literature and to support the researchers and practitioners in this field.

Chapter 28 assesses blockchain-based smart contract applications in the tourism industry. The main aim of the study is to design the bases of the blockchain system and the creation of smart contracts and to generate a new blockchain in the financial payment system. In the scope of the study, the technology under the blockchain system and smart contracts were examined. In light of the information obtained, a reliable, transparent, accountable simplified blockchain data structure as a result of intensive use of data and goods can be used in smart contracts in the financial payment system in tourism enterprises.

Chapter 29 analyzes Bitcoin jumps and speculations finding empirical evidence from high-frequency data. The aim of this chapter is to investigate the relationship between the jump dynamics of Bitcoin prices and the speculations by using high-frequency data. Prof. Yalaman measures the significance of the jumps using Huang and Tauchen (2005) nonparametric test and Google's Trends statistics for the measurements of the speculation. The results show that there is a discrete jump in the Bitcoin price around speculations and the futures contracts do not have any significant effect on this relationship, but notably after the launch of the futures contract, the speculations have a much higher significant effect on the Bitcoin jumps.

Chapter 30 develops an institutional and practical approach to taxing the "Un"Taxed digital economy with a focus on India while decoding the outsourced holding company model. The chapter presents a theoretical model to show how liberal tax laws have always been attractive for shifting profits. In this background, the chapter discusses the outsourced holding company model of tax avoidance used by digital business platforms like Flipkart with a special focus on India and hence decoding the tax design that can be operationalized by the fiscal authority to ensure increased tax revenues from digital value creation under such a case.

This book gathers colleagues and professionals across the globe from multicultural communities to design and implement innovative practices for the entire global society of business, economics, and finance. The authors of the chapters in this premier reference book developed a new approach to transformational change in business operations in the digital era with an elaborate understanding of digital business strategies on the basis of the blockchain ecosystem.

Finally, distinguished authors and professionals contributed to the success of existing literature with their theoretical and empirical studies in this novel book.

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Contents

Part I Business Model Design in Digital Era

1 Transformation of Business Model in Finance Sector with Artificial Intelligence and Robotic Process Automation 3
İlker Met, Deniz Kabukçu, Gökçe Uzunoğulları, Ümit Soyalp, and Tugay Dakdevir

2 Human-Robot Interaction in Organizations 31
Ayşegül Özbebek Tunç

3 Internet of Things in Blockchain Ecosystem from Organizational and Business Management Perspectives 47
Songül Zehir and Melike Zehir

4 A Blockchain Based Framework for Blood Distribution 63
Mehmet Çağlıyangil, Sabri Erdem, and Güzin Özdağoğlu

5 Developing a Supportive Culture in Digital Transformation 83
Güney Çetin Gürkan and Gülsel Çiftci

Part II Digital Transformation of Business Operations in the Blockchain Ecosystem

6 Digitalization of Business Functions under Industry 4.0 105
Melissa N. Cagle, Kevser Yılmaz, and Hümeyra Doğru

7 A New Marketing Trend in the Digital Age: Social Media Marketing 133
Selay Ilgaz Sümer

8 Transformation of Supply Chain Activities in Blockchain Environment 153
Goknur Arzu Akyuz and Guner Gursoy

9 Digitalization in Logistics Operations and Industry 4.0: Understanding the Linkages with Buzzwords 177
Metehan Feridun Sorkun

10 Digitalization of Business Logistics Activities and Future Directions 201
Ebru Beyza Bayarçelik and Hande Begüm Bumin Doyduk

11 Digital Transformation of Human Resource Management: Digital Applications and Strategic Tools in HRM 239
Pelin VARDARLIER

12 The Transformation of Human Resource Management and Its Impact on Overall Business Performance: Big Data Analytics and AI Technologies in Strategic HRM 265
Cemal Zehir, Tuğba Karaboğa, and Doğan Başar

Part III Digital Business Strategies and Competencies

13 Key Success Factors for Strategic Management in Digital Business 283
İlker Met, Ertuğrul Umut Uysal, Kadir Serhat Özkaya, and Esra Orç

14 Platform Strategy for Business Transformation in a Blockchain Ecosystem 305
Sang-Wuk Ku

15 Blending Business Strategies with IT in Digital Era 317
İlker Met, Ertuğrul Umut Uysal, and Esra Orç

16 Recent Developments of Artificial Intelligence in Business Logistics: A Maritime Industry Case 343
Gökçe Çiçek Ceyhun

17 Use of Artificial Intelligence as Business Strategy in Recruitment Process and Social Perspective 355
Pelin Vardarlier and Cem Zafer

18 Digital Marketing Strategies and Business Trends in Emerging Industries 375
Buket Özoğlu and Ayşe Topal

19 Structure and Strategy in Virtual Organizations: Strategies for Virtual Travel Organizations 401
Nilüfer Vatansever Toylan and Yasin Çakırel

Part IV Accounting Applications in Blockchain Ecosystem

20 The Doors Are Opening for the New Pedigree: A Futuristic View for the Effects of Blockchain Technology on Accounting Applications 425
Soner Gökten and Burak Özdoğan

21 A Critical Approach to Accounting in the Digital Era: Assessment of the Impacts of Industry 4.0 on Financials 439
Vildan Evrim Altuk and Ali Kablan

22 How to Use Blockchain Effectively in Auditing and Assurance Services 457
Ipek Turker and Ali Altug Bicer

23 Reflections of Digitalization on Accounting: The Effects of Industry 4.0 on Financial Statements and Financial Ratios 473
Melissa N. Cagle

24 Dark Factories from an Industry 4.0 Perspective: Its Effects on Cost Accounting and Managerial Accounting 503
Ali Kablan

Part V Cybercrime, Legal Aspects and Relevant Topics

25 Evaluation of Cybercrime Economy via MCDM and Decision Tree Approaches: The Case of Zonguldak 521
Zafer Öztürk, Mehmet Pekkaya, and Muhammed Temli

26 Copyright and Intellectual Property in Digital Business: Issue of Protection and Retrieval of Investment in Intellectual Creation 555
Badar Alam Iqbal and Arti Yadav

27 The State of the Art in Blockchain Research (2013–2018): Scientometrics of the Related Papers in Web of Science and Scopus 569
Guzin Ozdagoglu, Muhammet Damar, and Askin Ozdagoglu

28 Blockchain Based Smart Contract Applications in Tourism Industry 601
Seda Karagoz Zeren and Engin Demirel

29 Bitcoin Jumps and Speculations: Empirical Evidence from High-Frequency Data 617
Abdullah Yalaman

30 Taxing the 'Un'Taxed Digital Economy with a Focus on India: Decoding the Outsourced Holding Company Model 631
Sovik Mukherjee

About the Editor

Umit Hacioglu is a professor of finance at Ibn Haldun University, School of Business, Istanbul, Turkey. Dr. Hacioglu has BA degrees in Business Administration and International Relations (2002). He received PhD in finance and banking for his thesis entitled "Effects of Conflict on Equity Performance." Corporate finance, strategic management, and international political economy are the main pillars of his interdisciplinary studies. As a blockchain enthusiast, he is recently working on strategic fit and design in business ecosystem with blockchain-based applications. He is the editor of *International Journal of Research in Business and Social Science* (IJRBS), *International Journal of Business Ecosystem and Strategy*, and *Bussecon Review of Finance & Banking*. Dr. Hacioglu is the founder member of the Society for the Study of Business and Finance (SSBF) and BUSSECON International Academy.

Part I
Business Model Design in Digital Era

Chapter 1
Transformation of Business Model in Finance Sector with Artificial Intelligence and Robotic Process Automation

İlker Met, Deniz Kabukçu, Gökçe Uzunoğulları, Ümit Soyalp, and Tugay Dakdevir

Abstract Organizations operating in this fast pace era must have a dynamic structure to be competitive in a volatile business environment both inside and outside. Automation and data are driving fundamental changes in our daily lives and in the way of doing business. In this respect transforming business processes call upon the technological advancements of two rising technologies of today: artificial intelligence and robotic process operations in finance sector is analysed in terms of their ability of business models in digital age. These two emerging technologies will lead to a transformation in the customer service model and internal operation processes in finance sector with current and future potential impacts. The institutions should prepare their business models and employees for this future in order to turn this development into an opportunity. In this study, it is evaluated that how financial institutions should change their business models in order to benefit from these two developments and a use-case of a bank has been shared.

1.1 Introduction

When history of humankind and its transformation is considered, the point of convergence among social theorists is the economic and technological developments throughout the world. After hunter gatherers and feudal societies, the driving motive begins with the endeavour of getting a big slice of the cake, which is industrialization period. There is quite an amount of knowledge about the industrialization stories of developed countries who occupy a big space in the history of technology that ignited industry 4.0 too. According to Levy's anthropological spaces (Lévy & Bononno, 1997) since 1980's we are living in knowledge space after territorial and commodity

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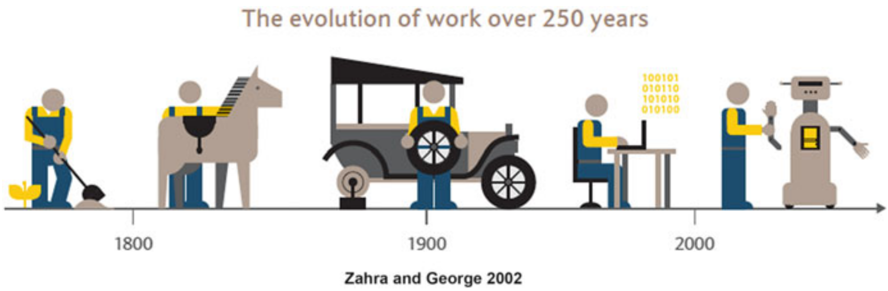

Fig. 1.1 The evolution of work over 250 years (https://www.investmentbank.barclays.com/content/dam/barclaysmicrosites/ibpublic/documents/our-insights/Robots-at-the-gate/Barclays-Impact-Series-3-Robots_at_the_Gate-3MB.pdf, 2018)

spaces. In parallel, Kitchin (2014) explains four paradigms of science through four paradigm shifters; experience, theory, computer science and big data. According to him, before renaissance there was natural phenomena that is experimental science, empiricism, before computer technology there was science modelling and generalization, before big data there was computational science simulation of complex phenomena and by now fourth paradigm of science is exploratory science and that is through data intensive methods, statistical exploration and predictive modeling (Fig. 1.1).

"The illiterate of 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn" (Toffler, Hyman, Abels, Abels, & Richmond, 1970). The dilemma is that easiest to learn and easiest to execute, is also the skills that are easiest to digitize, automate and outsource according to OECD Center for Educational Research and Innovation (OECD, 2017). The hidden agenda of capability to adapt change in organizations is precious since continually evolving learning capability of a business is not easy to understand, codify and replicate. Therefore, the absorptive capacity of organizations becomes more of an issue in building the dynamic capabilities in terms of the firm's changing technologic and strategic environment. When the firm's potential and realized capacity is distinguished, the firm's potential and realized capacities can differentially influence the creation and sustenance of its competitive advantage by advancing a model outlining the conditions (Zahra and George, 2002).

Today's on-demand economy, data analytics is extremely powerful tool to push digitalization in to work. Information technology systems, customers, ecosystems and things of the organization form the digital infrastructure to build up business in terms of processes and decisions. Therefore, business outcomes rely heavily on digital context where Buckminster Fuller claims in information doubling curve that, until eighteenth century human knowledge doubled almost in every century (Fuller & Kuromiya, 1981). By the mid of eighteenth century, knowledge was doubling in every 25 years. Today on average human knowledge is doubling in approximately 1 year. In near future knowledge doubling is estimated by IBM to be in every 12-h (Schilling, 2013). Data is driving fundamental changes in our daily lives and in the way of doing business. The ability to make easy data-driven decisions is becoming vital in the way that we all live and work which should be the same way that businesses provide services.

The pace of technological change introduces sophisticated, data-driven approaches to engage the strategic business objectives. The challenge of adapting continually to changing business world is to adapt ongoing business models according to environment, “The art” of today’s management concept. According to Gartner, strategic goals of information technology leaders are to embrace growth, not only cost reduction (Gartner IXPO Symposium 2018) inferring that technology is not only a supportive player in organizations but also a strategic tool for adapting change that makes significant contribution to business value.

New technologies are to absorb for evolving and interacting the future business and survival. The automation process, which began in the 1900s, was replaced by digitalization. How the institutions that failed to adapt to this situation in the 1900s had to undergo transformation, today the institutions that cannot digitize their processes will not be sustainable.

Digitalization processes will cause major transformations, especially in business models of financial institutions. This article focuses on transforming business processes call upon the technological advancements of two: artificial intelligence and robotic process operations in finance sector.

1.2 The Effect of Digital Technologies on Customer Behaviors

Consumer behavior; can be defined as a processes that include decisions about the selection, purchase, use and disposal of products and services in order to meet the wishes and needs of individuals or groups. There are many factors that affect cultural, social, personal and psychological factors in consumer behavior. In the digital age, technology has a major impact on behavior by influencing these factors.

Nowadays, people quickly adopt the technology that has started to use digital and mobile in a more dynamic way than ever before. Consumers are now investigating products and services in detail, while sharing their purchase methods and experiences after purchase. The behavior of the consumerist society is changing with the unlimited communication provided by digital.

Technologies such as social networks, mobile computing, artificial intelligence and analytics, cloud computing, VR-AR, chatbots create changes for both consumers and companies. Customers now expect unlimited communication from businesses and expect more responsibility from companies in purchasing services and products. Increased comfort with technology and high utilization of online channels feed this change faster.

Digitalization has also changed the way consumers interact with financial providers. In traditional methods, face-to-face communication has created many different channels with the development of technology. In addition to digital channels such as telephony, ATM, kiosks, internet and mobile, now instant financial services are provided that is supported by virtual assistants assisted through artificial intelligence and make the customer journey perfect.

The digital age allows firms to identify the strengths of solving problems that arise in customer journey, and to proactively address complaints and potentially even before they occur. For example, widespread adoption of social platforms makes services and products increasingly transparent. Nowadays, a customer is able to share its bad experiences with hundreds of potential customers instantly and the effect can spread to millions of people by clicking a button. The impact of this digital ascent does not only punish a company for poor services. Through positive messages from satisfied customers, a company adds value to its reputation for good service or excellent products.

1.3 What Is Artificial Intelligence (AI) and Historical Development of AI

By the early twentieth century, science fiction scenes become reality. Everything started with the question whether the machines could think. The term artificial intelligence was used by John McCarthy, who is accepted by majority as father of AI, at a conference in 1956 for the first time. Hence the studies on the possibility of thinking and understanding of machines have been started since then. Artificial Intelligence (AI) is simply and strikingly defined as; "It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable." (McCarthy, 1998).

By the mid of the century, AI gained a new dimension that Alan Turing introduced the mathematical existence of intelligence, the algorithms. The foundations of machine learning started to come into being.

The first artificial intelligence studies were conducted in the 1950s focused on issues such as problem solving and symbolic methods. In the 1960s, scientists worked on algorithms to solve math problems and brain teasers. In the late 1960s, under the influence of the Cold War computer science started train computers to generate human intelligence through machine learning and gave efforts on the development of machine learning in robots by the support of US Department of Defense. For instance, the Defense Advanced Research Projects Agency (DARPA) completed street mapping projects in the 1970s. The first "intelligent" humanoid robot, WABOT-1, was built in 1972 in Japan.

Despite the large-scale global effort and researches on the development of artificial intelligence starting from the 1970s, continued for a while and slowed down due to the inadequacy of computer scientists to obtain data and computers to process data. Inadequate results in this period; governments and companies have also reduced their faith in AI as it is today for blockchain technology that is represented in disillusionment through of Gartner's 2018 hype-cycle for emerging technologies. Thus, from the mid-1970s to the mid-1990s, there was a serious financial shortage for AI research which known as "AI Winters".

The 1990s were the beginning of a new era for artificial intelligence. Intelligence games were striking as a good experimental field for artificial intelligence and algorithm development.

Beginning with the emergence of artificial intelligence against human games like chess which has always been closely linked with the intelligence, a concrete struggle from the intellectual dimension has been a turning point in the history of artificial intelligence. In 1997, the victory of world chess champion Garry Kasparov against IBM's artificial intelligence program, Deep Blue, is one of the most important steps in the history of artificial intelligence.

Next step was the age of artificial intelligence that challenges human intelligence through new games. In the 2000s; Watson's, the supercomputer developed by IBM, has gained a triumph at the Quiz of Risk, and has made a great impression on daily lives peoples. Then, AlphaGo, developed by DeepMind, that is a Google Artificial Intelligence company, was the first program to beat a world champion of "Go" game in 2016, and was one of the best examples of artificial intelligence that convergence on human intelligence.

The vast amount of AI implementations we have been witnessed from playing chess with computers to self-driving cars, deep learning and natural language processing were the tools of training for computers to perform certain tasks by processing large amounts of data and recognizing patterns in the data.

Machine learning is one step further of AI that enables machines to learn from experience, adapt to new inputs, and do human-like work. Machine learning is a data analysis method that automates analytical model creation. It is a branch of artificial intelligence based on the idea that systems can learn from data and defined patterns to make decisions with the least human intervention.

The types of artificial intelligence algorithms and the types of these algorithms that interact with human life over the years are classified as supervised learning, unsupervised learning and reinforcement learning. Speech recognition, weather forecasting, recommendation engines, robotics and autonomous vehicles are respectively some of the signs in AI evolution.

The further step of machine learning is deep learning. Today, AI is in the phase of deep learning which is a kind of machine learning that trains human fulfillment functions such as image identification, comprehension or forecasting. Instead of editing the data that will work with predefined equations, deep learning creates the basic parameters of the data and educates the computer on its own by recognizing patterns using many processing layers.

In that sense deep learning is used to classify images, recognize conversations, identify objects, and identify content. Today's virtual assistants (systems such as Siri and Cortana) are partially supported and learned in depth.

Artificial intelligence continues to be a developing technology that can revolutionize all industries and cause a paradigm-shift in innovation spectrum. Deployment of artificial intelligence in organizations provides drastic reduce in hard-working hours that leads dramatic reduce in labor costs, create new and fertile in formation clusters, discover new models of industrial algorithms, and build models of forecasting from data to drive actionable insights.

Over the last 5 years, there have been developments beyond the predictions of Artificial Intelligence and advanced machine learning. Today, artificial intelligence systems offer different solutions in many different sectors. Health, Customer Services, Banking, Automotive, Security, Insurance are the leading sectors in these sectors. Therefore all sector businesses need to develop new strategies to gain advantage in the market to dominate and to remain competitive amongst rivals.

Milestones to adapt change and be a game-changer can be summarized as follows:

- Development of information network,
- Establishment of cost effective infrastructures,
- Cloud solutions in data storage,
- Ability to integrate processes (IoT sensors, wearable devices, mobile devices, etc.),
- Rapid development of algorithms (deep learning, simulations, natural language processing, etc.).

1.4 What Is Robotic Process Automation (RPA) and Historical Development of RPA

Automation is transformative for businesses in terms of velocity of operations, cost reduction, shifts customer experience while save time for employees to self improvement and value added customer oriented activities.

The development of automation capability started with Enterprise Resource Planning (ERP) systems in the 1970s. ERP systems have a structure that is based on changing the processes on existing applications. Since it is costly to change infrastructure and the implementation, in following 10 years businesses shift to Business Process Management systems. But, BPM's software is limited to API integrations that push business professionals to define new processes on existing processes (Fig. 1.2).

The concept of Robotic Process Automation, which is more of an issue today, was invented by Blue Prism in 2012, developed from an automation consultancy for banks and financial services companies. In this respect, the last phase of the automation wave, Robotic Process Automation, has been the focus of creating digital workforce for all industries in the recent years.

Robotic Process Automation (RPA) is a kind of software that generates the steps in performing by a person in the process. Robots are programmed to do faster, more accurate and continuous/repetitive tasks than humans.

It works by recording the same processes as human beings with RPA technology and applying them by the process boots. In this process, there is no need for process

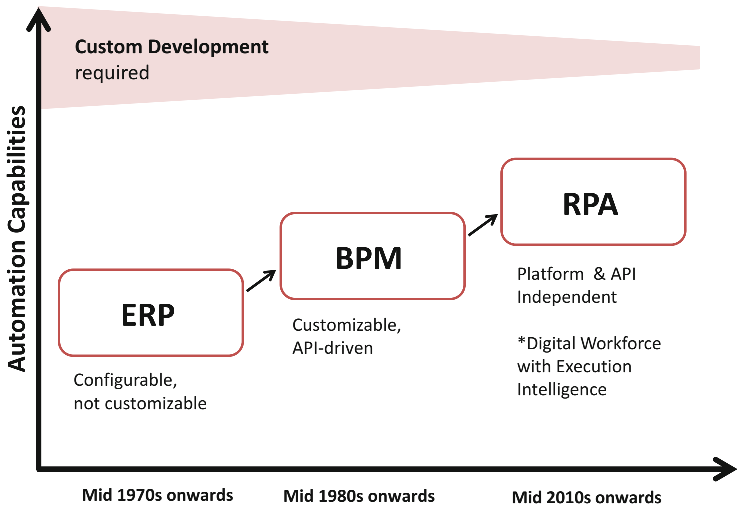

Fig. 1.2 The evolution of process automation technology (https://www.lateetud.com/the-evolution-of-process-automation-technology Web. 29 January 2019)

and substructural change through existing user interfaces. Since RPA uses existing applications in the process, integration into any system is not necessary.

We can list the basic processing capabilities of RPA as follows;

- Information gathering, sorting and verification,
- Synthesis and analysis of structured and unstructured data
- Saving and transferring information and data
- Calculation
- Communicating and supporting users and customers
- Monitoring, detection and reporting

Robot technologies are easily used in sectors where rule based, repetitive and structured data inputs are mature in workflows. Financial sectors are the most important of these sectors.

Activities of Banks, Insurance Companies and other financial service institutions; has strict regulations on transparency, security, data quality and operational flexibility. In this sense, RPA plays an important role in meeting the needs of modern banks such as speed, quality and low cost.

It has both financial and non-financial advantages as it is consistent and error-free in operations performed by the robot. According to an Accenture study (Accenture: Robotic Process Automation, 2019) on what processes are relevant for robotic process automation in companies are accounted as;

- Average 80% reduction in costs
- High quality output free of human errors
- Up to 80–90% time saving in standard jobs
- Fast Integrations (without the need for large projects)

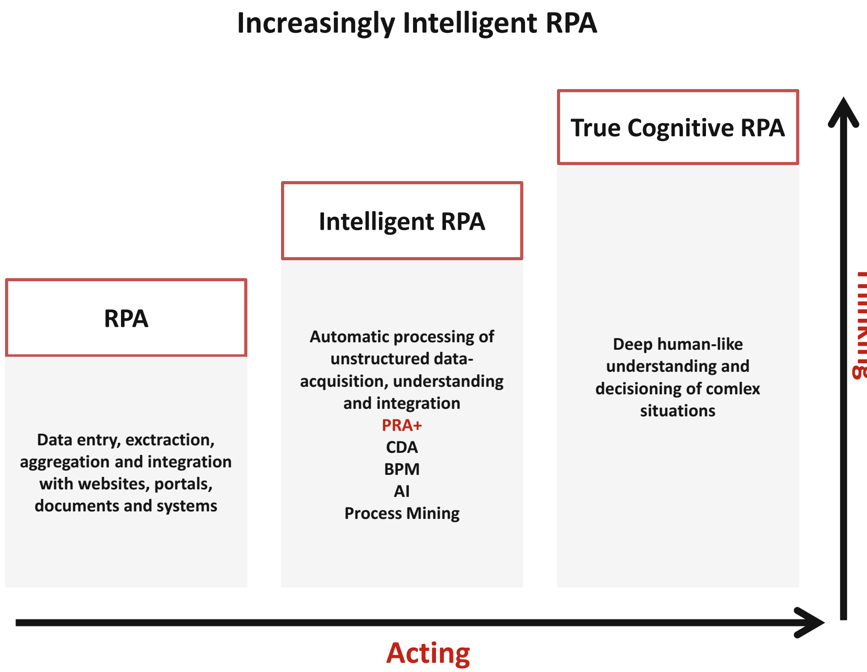

Fig. 1.3 "RPA-past and future" (https://www.kofax.com/Blog/2018/august/robotic-process-automation-rpa-past-present-and-future Web. 29 January 2019)

The predictions of Gartner for 2018 are realized 80% that the company categorized the development of Robotic Process Automation as an "early acceptance stage". It also foresees that this acceptance process will continue until 2020 for a mature life cycle where many organizations develop rational strategies of adaptation with the interest of many organizations becoming rational.

Twenty-First century; virtual workforce; the robots represent the human muscle power, and the intelligence that is the generic-for human intelligence. Thus, it is possible that an integrated human prototype will carry automation into the future.

While robots are involved in repetitive and data-related tasks, people will be involved in more complex value added tasks and insights to take actions and make decision-making (Fig. 1.3).

Vice President of KOFAX, Russ Gould; envisions that in the future of automation, it will reach the highest level of thinking and similar behavior with Intelligent RPA and True Cognitive RPA period while emphasising the benefits of current RPA technology such as operational quality, velocity and cost of production in organizations.

In order to have deeper understanding the ability of these technologies to transform our daily lives and eventually the business habitat, their effects on business model transformation and internal process transformation will be discussed in detail.

1.5 How Will AI and RPA Effect Financial Institutions? Use Cases of AI and RPA for Financial Institutions

Artificial intelligence and robotic process automation have a very important role in the transformation of business models of financial institutions. These technologies will provide significant transformations both in customer processes and internal processes of institutions.

1.5.1 Customer Service Model

Artificial Intelligence, it is more effective in the digital world. The sectors that want to realize business transformation through technology innovation should not ignore the effect of artificial intelligence. It should be kept in mind that artificial intelligence and Robotic Process Automation are able to automate or enhance human activities, that the customer experience and the transformation of companies will be more effective and actionable.

In researches conducted, firms state that they are integrating or will be integrating Artificial Intelligence technology into their existing systems in customer engagement applications.

According to Gartner's research, all three categories of applications for such integrations are related to customer interactions (Fig. 1.4).

One in three organizations they surveyed said they will link AI to customer engagement applications. Three in ten said they will integrate AI into call center service and support. One in four said they will integrate AI into digital marketing (Walker, Andrews, & Cearley, 2018).

In the processes where the customer is located, artificial intelligence and robotic automation technologies are developing rapidly. In customer processes, firms should always keep their agenda on the ability of artificial intelligence to use their capabilities.

1.5.1.1 Sales and Marketing Processes

The effect of artificial intelligence and robotic process automation technology on customer processes is undeniable. In the finance sector, artificial intelligence and RPA technology are spreading in sales and marketing areas in order to maximize the communication with the customer, to be always with the customer and to provide an excellent customer experience. In customer relationship management, the finance sector also benefits from AI while changing customer service models. The transformation of the customer service model with artificial intelligence and RPA in the financial sector will be inevitable. Those who make this transformation fast will have a competitive advantage.

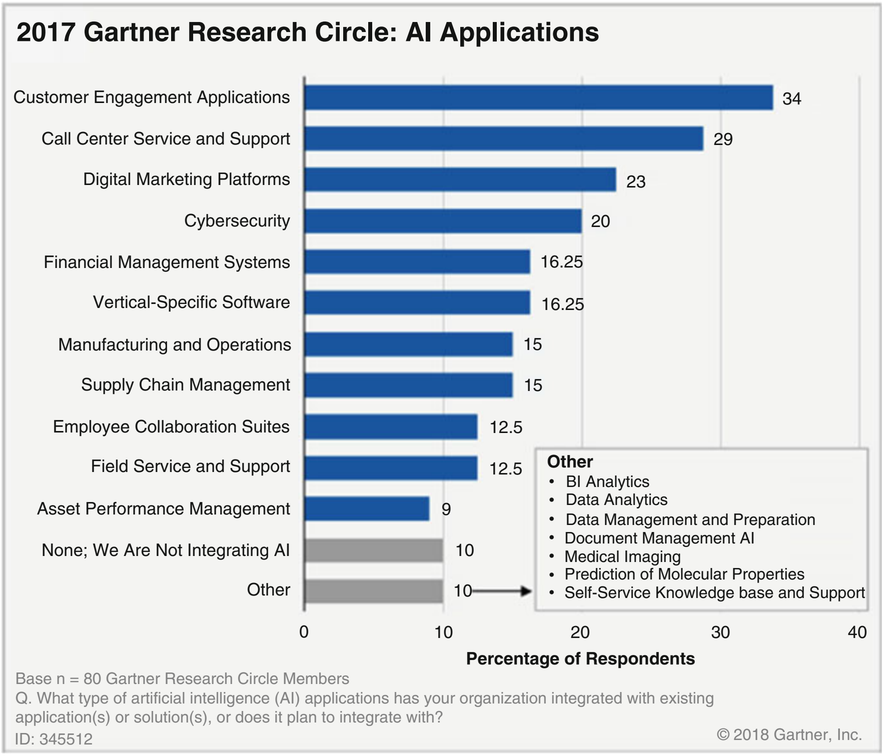

Fig. 1.4 "Gartner's research circle AI survey results breakdown" ("Top 10 strategic technology trends for 2018: AI Foundation." M. Walker, W. Andrews, D. Cearley. Gartner Published: 2018, ID: G00345512)

The most important factor by marketing and sales teams is to understand customer behavior and getting to know the customer. In the past, the face-to-face communication could only analyze the current situation of the customer and not comment on their future behavior. A social analysis was tried to be done with the questionnaires. In the digital age, a lot of data is obtained about customers who interact with many channels. This is exactly what marketing and sales teams need. Now customers can be recognized and offered an excellent customer experience. However, this may be possible by making the data obtained meaningful. With artificial intelligence analytics, customer data becomes meaningful; customers can be evaluated personally, customer needs can be correctly identified and real-time campaigns can be offered for each customer; instant decision support systems can be created; will be of great support to companies in offering products and services.

When we look at examples in the financial sector, artificial intelligence and RPA are used in marketing and sales areas:

– By creating customer data platforms (CDPs), a holistic view of the customer can be provided. Customer data is collected from different sources, and identity, behavior, purchase and demographics are combined in a single record. And thus the customer can be optimized by providing more detailed segments.

- By analyzing customer's movements, real-time campaign management can provide the right product to the customer. In fact, the needs of a future date can be determined and the customer can be directed.
- Virtual personal financial advice can be offered to customers. Clients can be provided with artificially intelligence virtual assistants with information to help them manage their personal expenses and assess their savings.
- Customer efficiency and risk can be analyzed by artificial intelligence models and dynamic pricing can be offered to each customer in services and financial products to be used.
- Analysis of past behaviors of customers and artificial intelligence-assisted decision support systems and early warning signals can be generated.
- Real-time operations can be used in estimation and modeling and fraud detection.
- With artificial intelligence and RPA, tasks can be automated. It is the use of intelligent dial-up that can summarize contract data—intelligent technology takes structured and unstructured data, extracts relevant key items from contracts, needs attention, reduces the amount of text to read, and allows employees to focus their time on the relevant items (Garner: Hype Cycle for Artificial Intelligence, 2018).
- It can be ensured that the transactions can be made by RPA by conducting financial transactions of the client via chatbotlar and social media channels and forwarding the instructions through virtual assistant.
- Physical channels, such as branches and ATMs, can be analyzed using IoT technology. Customers in the environment can be analyzed to show the appropriate ads or densities can be directed.

By creating end-to-end digital processes with artificial intelligence and RPA, an excellent customer experience can be created for the customer.

1.5.1.2 Digital Channels and Customer Services

Companies in the financial sector have developed a number of channels to reach customers. Through marketing and sales activities, they have continuously increased their communication with the customer. In the digital age, they benefit from destructive technologies, especially artificial intelligence and RPA. Companies are trying every way to reach customers at the right time. In today's world, customers expect unlimited responsibility and accessibility from companies. In other words, customers want to receive and perform their services whenever and wherever they need, and expect immediate solutions to their problems, that is called on-demand economy. In this respect, alternative channels such as ATM, telephone, kiosk, internet and mobile etc. have been developed, call and contact centers have been designed according to new technologies. For this reason, with artificial intelligence, existing channels are redesigned to maximize customer experience. In artificial intelligence technology, chatbot and personal virtual assistants are the most common applications in companies that want to improve their natural language processing and comprehension and to develop their digital channels. VCAs are an area of strong interest as they are now being deployed in mobile apps, websites, customer self-service portals, peer-to-peer communities, consumer messaging apps and kiosks (Thompson et al., 2018).

Chatbot and Personal Virtual Assistants are constantly evolving and are now integrated not only with communication but also with back systems. Now they have gained the ability to act on behalf of customers. Today, their requests and problems can be answered with artificial intelligence instantaneously.

Companies also use chatbot and personal virtual assistant applications not only on their own channels but also on messaging platforms such as Facebook Messenger, WhatsApp, WeChat and LINE. Thus, they started to use them as channels and they were able to communicate with customers through social media.

With the influence of artificial intelligence in the digital age, call centers are entering a rapid transformation and people are replaced by bots (Fig. 1.5).

With the help of virtual assistants and chatbots, the financial sector has entered into a major transformation in customer service by communicating with users via text or voice in natural language through all channels and even social communication platforms.

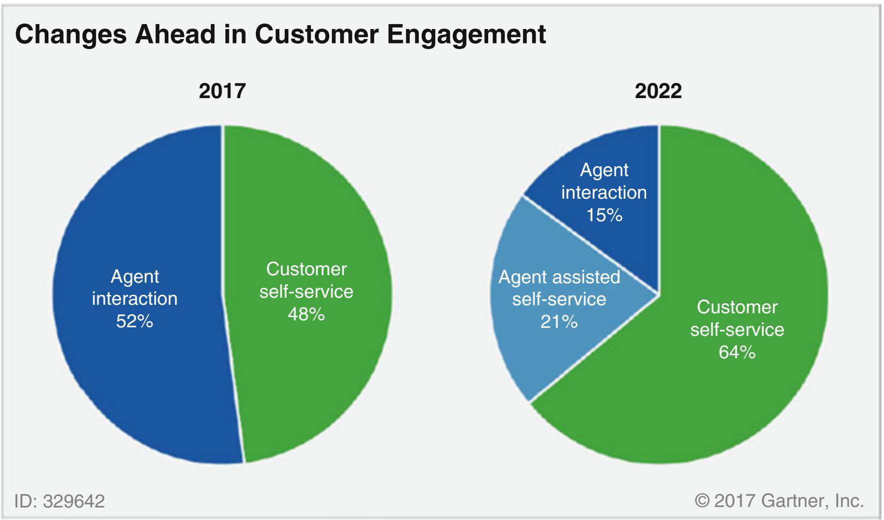

Fig. 1.5 "Customer service interactions, 2017 and 2022" ("AI will enable omnichannel to evolve into a postchannel customer experience." Maoz M. Gartner Published: 2017, ID: G00329642)

1.5.2 Back-Office Processes

Back-office is the function that fulfills the operational processes supporting the sales processes in financial institutions. Labor costs in operational costs are important. Therefore, efficient operation of back-offices in financial institutions provides significant competitive advantage. Back-offices have always been an important center for the transformation of financial institutions. Fast and error-free operation is very important for customer satisfaction and loyalty. Efforts to perform error-free and fast transactions with low costs have been an important priority of the financial sector. Back-office operations often involve repetitive, non-decision-making processes or very simple decisions. These processes are the easiest to automate as they are frequently repetitive standard processes. Robotic Process automation is expected to affect back-office processes in the finance sector. Financial institutions standardize the back office processes and collect them under Operation Centers to make them more efficient. Now, they have the chance to destroy these centralized operational processes with the applications of automation and artificial intelligence. In accordance with the instructions of the customers/branches, the remittance transactions, tax payments, bill payments etc. can now be carried out by digital workers without the need for a real employee.

Processes can be automated by integrating with artificial intelligence in the processes that need to make simple decisions.

In finance and accounting, adoption of RPA several use cases exist, including:

- Collecting through email/spreadsheets and posting entries into a centralized general ledger.
- Processing all data required for intercompany transfers that may be within a single general
- Ledger (GL) or extend beyond multiple GLs.
- Routing of invoice data through PDFs and then rekeying invoice data from an accounts payable tool or a central invoice repository into accounts payable systems of record.
- Supporting order entry processes, including order taking, customer credit checking, stock checking for parts to fulfill orders and pricing calculations.
- Collecting data from the enterprise as part of the financial close process before entering it into a financial close business application.
- Collecting operational and financial plan data from enterprise sources, collating it, combining it and processing it offline before it is entered into a financial planning and analysis system.
- Checking if vendors are already listed in the vendor master file, and adding them if they are not in the file.

Here are some examples of where RPA and financial close solutions can be used:

- Extracting data from bank statements into reconciliation management templates.
- Gathering journal entry details from emailed spreadsheets to prepopulate journal entry routing solutions or core-financials-based journal entry screens.

- Collecting nonfinancial system metrics, PDFs/backup details and input for disclosure solutions.
- Automating the email confirmation process when needed across the financial close cycle.
- Comparing account balances when a separate reconciliation management solution (business application) is not used.
- Automating the manual processes needed to prepare input for intercompany transfer processes and solutions.
- Uploading bank account balances from bank systems to treasury systems and placing the data in a format the treasury system can process. Much of this is still manual today.
- Distribute treasury system reports to local finance personnel to communicate balances.

As a result of these developments, back office/operation centers will be reduced, technology-intensive processes will enable more efficient and low cost operation.

1.5.3 IT Function

The role of IT function is changing after integration of automation applications and integration with organizational processes.

There is no need to know programming to develop process through these applications. Application interfaces are designated to design the process without the need to do software. RPA is lightweight IT that benefits from business-IT cooperation (Willcocks, Lacity, & Craig, 2015).

Behind the scenes, IT functions are devoting anything between 30 and 70% of their effort and cost on maintaining existing legacy systems (Willcocks et al., 2015). With automation applications, maintenance work on the IT function is expected to decrease. Robotic Process Automation Applications use the existing systems and infrastructures, thus reducing the need for the IT function in the automation needs of business units and thus the pressure of business units on this function. Thus, the IT function can focus on different jobs with high business value. Business units will also not have to wait for restricted IT resources to meet development requirements.

1.5.4 Problem Management Processes

Institutions can transform the platforms where employees communicate their daily problems and offer solutions by artificial intelligence and robotic process automation integration. Virtual assistants often used in customer service processes in the financial sector can play an important role in solving internal problems. By 2020, one in five white-collar workers will use a virtual employee assistant (Searle, 2018) (Fig. 1.6).

Impacts	Top Recommendations
Virtual assistants will reshape employee experience by democratizing access to complex enterprise systems.	▪ Buy or build virtual assistants to improve staff productivity. Determine use cases to benefit specific employee groups — such as task delegation, information queries or automating customer interactions.
Immersive experiences will provide more meaningful ways for employees to perceive the digital workplace.	▪ Create a pilot project that leverages an immersive experience to provide a more engaging way to deliver tasks such as employee training and collaboration.
Robots will offer new opportunities to replace or augment work and create new efficiencies.	▪ Identify specific opportunities where robots can augment business processes. Leverage robotics as a service to trial robot use to improve productivity.

ID: 348690 © 2018 Gartner, Inc.

Fig. 1.6 "Impacts and top recommendations for CIOs assessing the impact of virtual assistants, immersive experiences and robots on their digital workplace" (Gartner, How virtual assistants, immersive experiences and robots will impact your organization, 2019)

Virtual Assistants Are Reshaping the Employee Experience by Democratizing Access to Complex Enterprise Systems (Searle, 2018).

A virtual assistant can be created for employees with an integrated chat-bot application. Virtual assistants contribute to increasing productivity by providing quick solutions to employees' problems.

- Learned solutions can be presented by understanding the daily problems faced by employees with virtual assistants.
- With the integration of robotic process automation application, virtual assistants can perform simple tasks (password renewal, meeting planning etc.) on behalf of people.
- Meeting planning, meeting invitations, meeting room can be booked with virtual assistants.

1.5.5 Fraud Processes

Fraud management has become one of the basic functions for banks. It is possible to create effective solutions with the integration of artificial intelligence and robotic process in performing this function.

According to the 2018 Gartner CIO Survey, one in three CIOs are actively planning an AI project, which is one of the highest among all the industries. CIOs in banking and investment services are using fraud analysis on:

- Transactional data (41%)
- Marketing department customer segmentation (24%)
- Call center virtual customer assistants (13%)
- Sentiment analysis or other opinion-mining analysis (12%)

- AI-based applications for virtual personal assistants (9%)
- HR applications, such as resume screening (7%)
- Anomaly or fraud detection on Internet of Things (IoT) data (5%)

Banks using artificial intelligence in fraud processes;

- With natural language processing (NLP); integrate unstructured data sources into their scenarios.
- With social media listening; classify real-time events and discover critical events.
- Design effective scenarios by machine learning.

Banks using robotic automation integrated with artificial intelligence in fraud processes;

- They can make necessary notifications with robotic software.
- Fast action (blocking, card cancellation, etc.) can do with robotic software.

1.5.6 Cyber Security Processes

With advances in technology, cybercrime also tends to increase. Cyber infrastructures are very vulnerable to intrusions and other threats. Physical devices such as sensors and detectors are not sufficient to monitor and protect these infrastructures. Therefore, more complex systems/models that can model normal behaviors and detect abnormal behavior are needed. These cyber-defense systems need to be flexible, adaptable and robust and capable of detecting a wide variety of threats and making smart real-time decisions. Traditional fixed algorithms have become ineffective in combating dynamically evolving cyberattacks. Therefore, we need innovative approaches such as the application of Artificial Intelligence (AI) methods that provide flexibility and learning ability to software that will help people in the fight against cybercrime (Dilek, Çakır, & Aydın, 2015).

1.5.7 Human Resources

The gaining value of use of information by means of new meaning has brought both social transformation and change and has been accepted as the precursor of every new age. Although there are many factors that enable the transformation from agriculture to industrial society, from industrial society to information society, the role of human and its knowledge in the basis of this transformation and its realization comes to the fore (Beytekin, Yalçinkaya, Dogan, & Karakoç, 2010). While artificial intelligence and automation deeply affect our business processes and the way we do business, the skills of the employees need to be developed in this direction.

Artificial intelligence and robotic process automation have entered our lives as an important development area that will change the business model of finance sector.

According to 77% of CIO and business leaders, within 10 years, the knowledge and skills in our organization will have little similarity to what we have today (Morello, 2016).

According to the World Economic Forum's Future of Jobs 2018 report, artificial intelligence is among the first four important advantages that will positively affect growth in the period of 2018–2022. According to the same report, the processes carried out by robots/robotic processes by 2025 will exceed the working hours of people working hours are specified. With these developments, the new roles that will be needed in the organizations will emerge and some of the roles will be eliminated. Some knowledge workers will step up to even higher levels of cognition; others will step aside and draw on forms of intelligence that machines lack. Some will step in, monitoring and adjusting computers' decision making; others will step narrowly into highly specialized realms of expertise. Inevitably, some will step forward by creating next-generation machines and finding new ways for them to augment human strengths. With an augmentation mindset, knowledge workers will come to see smart machines as partners and collaborators in creative problem solving (Davenport & Kirby, 2015) (Table 1.1).

While the artificial intelligence and robotic processes are integrated into the business processes, the share of automation and algorithms is constantly increasing in the execution of the work carried out, and this situation makes great changes in the labor markets. Algorithms and robotic software continue to grow without the need for people to play a role. This situation reveals the necessity of people to have new skills in the future. The institutions and individuals taking action to identify and develop talent deficits will gain competitive advantage in this process.

According to the World Economic Forum's Future of Jobs 2018 Report, between 2018 and 2022, companies expect a significant change in the shares of people and machines allocation in existing jobs. In the 12 sectors that is surveyed in the report, have average of 71% total working hours are carried out by employees and 29% by machines. By 2022, the rate of work carried out by machines is expected to increase to 42%. With the increase in the number of jobs performed by automations and algorithms, employees will be given the task of developing new automation processes and algorithms. Therefore, new capabilities will be revealed and required to develop. Analytical thinking and innovation skills continue to stand out until 2022.

In addition, skills in technology management such as technology design and programming; 'human' skills such as creativity, authenticity and initiative, critical thinking, flexibility, complex problem solving, persuasion and negotiation, emotional intelligence will maintain or enhance their values (Table 1.2).

In the future, many jobs will be replaced by integrated artificial intelligence and robots/robot software. They will be capable of doing many jobs of today's human workforce that employee tasks will be naturally eliminated eventually. New skills and skills should not be missed today. In the information works, the strategy that will work in the long term for both the employer and the employee is to see the machines as partner and support force. You can eliminate the threat of automation by highlighting the supplements, transforming the race with the machines into a relay race rather than a depot (Davenport & Kirby, 2015).

Table 1.1 Examples of stable, new and redundant roles, all industries

Redundant roles	Stable roles	New roles
Data Entry Clerks	Managing Directors and Chief Executives	Data Analysts and Scientists
Accounting, Bookkeeping and Payroll Clerks	General and Operations Managers	AI and Machine Learning Specialists
Administrative and Executive Secretaries	Software and Applications Developers and Analysts	General and Operations Managers
Assembly and Factory Workers	Data Analysts and Scientists	Big Data Specialists
Client Information and Customer Service Workers	Sales and Marketing Professionals	Digital Transformation Specialists
Business Services and Administration Managers	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	Sales and Marketing Professionals
Accountants and Auditors	Human Resources Specialists	New Technology Specialists
Material-Recording and Stock-Keeping Clerks	Financial and Investment Advisers	Organizational Development Specialists
General and Operations Managers	Database and Network Professionals	Software and Applications Developers and Analysts
Postal Service Clerks	Supply Chain and Logistics Specialists	Information Technology Services
Financial Analysts	Risk Management Specialists	Process Automation Specialists
Cashiers and Ticket Clerks	Information Security Analysts	Innovation Professionals
Mechanics and Machinery Repairers	Management and Organization Analysts	Information Security Analysts
Telemarketers	Electrotechnology Engineers	Ecommerce and Social Media Specialists
Electronics and Telecommunications Installers and Repairers	Organizational Development Specialists	User Experience and Human-Machine
Bank Tellers and Related Clerks	Chemical Processing Plant Operators	Interaction Designers
Car, Van and Motorcycle Drivers	University and Higher Education Teachers	Training and Development Specialists
Sales and Purchasing Agents and Brokers	Compliance Officers	Robotics Specialists and Engineers
Door-To-Door Sales Workers, News and Street Vendors, and Related Workers	Energy and Petroleum Engineers	People and Culture Specialists
Statistical, Finance and Insurance Clerks	Robotics Specialists and Engineers	Client Information and Customer Service Workers
Lawyers	Petroleum and Natural Gas Refining Plant Operators	Service and Solutions Designers
		Digital Marketing and Strategy Specialists

World Economic Forum's Future of Jobs 2018 Report, 2018

Table 1.2 Comparing skills demand, 2018 versus 2022, top ten

Today, 2018	Declining, 2022	Trending, 2022
Analytical thinking and innovation	Manual dexterity, endurance and precision	Analytical thinking and innovation
Complex problem-solving	Memory, verbal, auditory and spatial abilities	Active learning and learning strategies
Critical thinking and analysis	Management of financial, material resources	Creativity, originality and initiative
Active learning and learning strategies	Technology installation and maintenance	Technology design and programming
Creativity, originality and initiative	Reading, writing, math and active listening	Critical thinking and analysis
Attention to detail, trustworthiness	Management of personnel	Complex problem-solving
Emotional intelligence	Quality control and safety awareness	Leadership and social influence
Reasoning, problem-solving and ideation	Coordination and time management	Emotional intelligence
Leadership and social influence	Visual, auditory and speech abilities	Reasoning, problem-solving and ideation
Coordination and time management	Technology use, monitoring and control	Systems analysis and evaluation

World Economic Forum's Future of Jobs 2018 Report, 2018

1.6 Robotic Process Automation and Artificial Intelligent Supported Transformation: A Financial Institution Example

Our organization has been carrying out a transformation program which was started about 7 years ago. We continuously improve our business processes to meet the changing needs and expectations of our customers and to benefit from the opportunities offered by technology. In line with the sustainable profitability objective, continuous improvements are made in order to achieve sustainable efficiency in all processes. For the last 2 years, we have been working on the integration of robotics process automation and artificial intelligence into processes.

In order to ensure that people are focused on jobs with high added value, projects carried out to reduce operations burden in the following fiction.

1.6.1 Simplification of Processes

Before starting the automation initiatives in our institution, we analyzed and simplified the processes with high number of transactions. For this, a team was created. With this study, inactive processes that need to be terminated have been canceled.

The processes that need to be simplified were determined and improvements were made. A total of 3240 FTE's were removed from the operational work.

1.6.2 Centralization of Operations

One way to remove operational jobs from branches is to centralize them. Thus, instead of wasting time on these jobs in branches, it can allocate more time to its customers and operational operations can be carried out more efficiently with expert team in the center. With this awareness, by centralizing the operational transactions in our branches, we achieved an operational savings of 2000 FTE's.

1.6.3 Robotic Process Automation Integration

To carry out the centralized processes with the robotic process automation application, in 2017 our research work on RPA started. Our aim was to perform simplified and centralized operational processes with digital labor. For this purpose, firstly, after the process of selecting the appropriate process automation application, appropriate processes were determined.

1.6.3.1 Establishment of the RPA Team Consisting of IT and Business Teams

Before the process of purchasing an RPA application, we first brought together the IT team with the experienced business unit team in the process design and improvement. The team consisting of six people conducted a detailed survey of RPA integration and identified a list of eligible products.

1.6.3.2 Product Selection

Our aim was to design the flow of business processes without the need for IT units on RPA application. While searching for the appropriate product, we have chosen a product that basically meets the following criteria:

There are many products offered as RPA application. But not all of them have the same features. The most important step in the RPA integration process is to identify the product that is needed.

- Receive simultaneous data from multiple systems
- Integrated and synchronous operation with a data capture application
- With the control room feature, you can plan according to the different rules

- Can report transaction results effectively
- Can design flow without programming knowledge

1.6.3.3 Determination of Proper Processes

In order to get adequate support within the organization, we tried to determine the processes in which we can get quick results. Therefore, we have started to work with two types of processes which have financial outcomes resulting in overtime work periodically. While working on proper planning, a scoring model consisting of the following criteria was established to determine the appropriate processes throughout the organization.

- Is the application testing environment?
- Is the entire process end-to-end run in the test environment of the application?
- Are users defined or appropriately authorized to use the application by the robot?
- Is there any use of Captcha in the process?
- Is there a return to the process for approval?
- Are there decisions made by a person in the process?
- Is there any document scanning, document loading process in the process?
- Does it need OCR?
- Are there an application/service to verify data read with OCR?
- Are the actions to be taken when the OCR reading fails/fails?
- Are there any actions to be taken by the robot in the event of errors during operation?
- Are there screens on the relevant application side for monitoring?
- Does the current process need improvement?

Robotic process automation (RPA) technology; is the software that performs routine work processes by simulating human and makes simple decisions. Some of the most important advantages of Robotic process automation are as follows; there is no need to make additional infrastructure investment since it uses existing systems, it is able to work 24/7, it is faster than human in performing operations while minimizing the risk and errors, it is enough to record the work that is done to teach bots without the need to code. Together with these advances, we started to implement RPA technology in our processes in order to utilize our employees in value-added areas by saving them from mass and routine works. We begin with a few processes, such as simple reporting that involves financial transactions to implement RPA technology to our processes. Then we proceed with following processes to be replaced by robotic process automation technology in our organization.

E-Notification Process

The Ministry of Treasury and Finance—Revenue Administration provides notifications regarding the company through web service. Before RPA, these documents were downloaded and merged by employees to be sent to the related unit via our in-house system. In this process, two employees were simply doing document downloads and document mergers and forwarding them to the relevant service. Today with RPA technology, this process has been automated in a very short time and two people have been saved from doing this routine work.

Now, the robot log in the system with its own user name and password at certain times downloads and combines the documents. The documents are automatically transmitted by the robot to the corresponding unit after the documents have been inserted into a suitable format. This routine work that is done by two employees is now replaced by robotic process automation. It yields eight times more than the old way of performing since it is faster and continuously operates.

Tax and Social Insurance Debt Collections

Our customers give instructions to our branches regarding the payment of taxes and social insurance debts. Customer instructions are scanned by the branch and sent to our Operation Center. The documents are read by the employees of Operation Center and the information in the document is found with the eye and the relevant fields on the screen are filled. The collection process is carried out on the system and the transaction information is sent to the branch. These processes, which come intensively on a periodic basis, reach ten thousand in some periodic days.

With the help of the process automation, the instructions that the customer sends to the branch and sent to the Operations Center by the branch are processed with data capture technology and the data is digitized. In this operation, only the required fields on the document were exposing with getting the optical character recognition (OCR). Thus a great speed was achieved here. Data digitized by data capture technology, the relevant areas on the screen are entered by the robots in seconds and customer debt is collected. Bot informs the branch that the customer's tax and social security debt has been collected. In addition, warning and control messages to the real person user are no longer necessary, with the improvement and automation of the process. The process has been digitalized by data capture technology and automated by robotic process automation technology, both a great speed has been achieved and the risk of error on persons has been eliminated (Fig. 1.7).

We are determined, in the near future, to complete the process by forwarding the instructions of the customers directly to the robot with the help of artificial intelligence assisted virtual assistant.

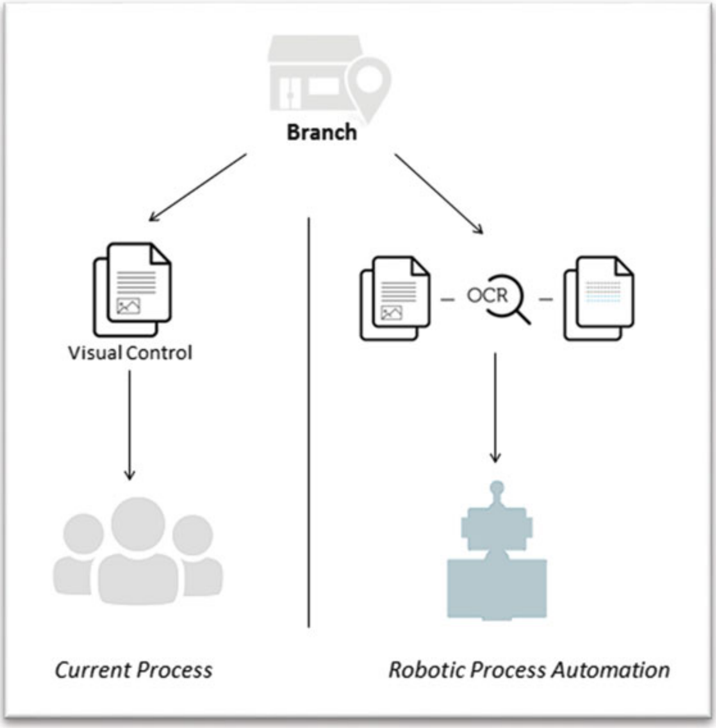

Fig. 1.7 Previous and new processes of tax and social insurance operations

Fleet Traffic Insurance Policies

Fleet traffic insurance process; firms send us vehicle information with consolidated excel document. Vehicle information is provided by our employees by entering the fields on the screen one by one and insurance is provided for each vehicle. This long and tiring process has been automated with robotic process automation. The document is sent by e-mail and the process is started by the robot. Information about each vehicle in Excel is quickly entered into the relevant fields on the insurance application by the Robot and the insurance process is performed. The insurance process for all vehicles is completed without stopping. With more than one robot, the insurance of a fleet with hundreds of vehicles can be done within a few hours. This speed offered to the customer provides a big increase in satisfaction level and makes the business a reason for preference.

In our organization, routine and batch processes that could be included in the robotic process automation project were determined and their gains were calculated. We continue to work on foreclosures, check-notes, customer complaints/satisfaction notifications, treasury operations and other insurance processes.

1.6.4 Artificial Intelligence Integration

The last step of our automation journey is integrating artificial intelligence. Our organization is endeavor artificial intelligence to become part of the transformation through chat-bots. Chat-bots are used by many companies to answer questions of their customers where the usage is hugely increasing. In a size like our organization, it is considered that chat-bots can be positioned for the fast solution to the problems of the employees within the organization. Therefore we developed an artificial intelligence-based chat-bot application for internal problem management. Problems encountered due to lack of software/hardware and information by employees during the day are solved through the service desk application integrated into the main banking application.

The number of calls made by the employees reaches 70,000 monthly on average. All calls are evaluated by service desk employees, they are directed to the relevant specialist unit and the expert unit solves the problem by writing a solution description or talking to the user. The user expects this process to be able to answer the problems. In addition, according to the call analytics, it is inferred that the majority of the calls made by the users were not require any expertise, not caused by any technical problem. Major call is done because of the lack of information which has been announced earlier or notices were given according to newsfeed within the organization. Therefore, a solution was then explored to prevent users from opening calls (Fig. 1.8).

Chat-bot applications are usually rule-based. In other words, the questions and answers given to the user are defined in a platform and then the user is expected to ask the closest similar question or to answer the question by understanding the question from certain words.

Our artificial intelligence supported chat-bot is improved by two statistical methods through Support Vector Machine approach. SVM can be defined as a machine learning algorithm that analyzes data for classification and regression analysis. It is also known as a controlled learning method by classifying data.

Our model includes banking dictionary that is developed in house. Thus, the level of understanding and success of the model is increasing day by day.

Since the platform that we use will be able to analyze the existing records and understand the questions asked by the users through doing text analysis from the whole sentence structure, success rate is expected to reach 80%.

By the internal problem management platform, employees started to find solutions quickly to the problems they face. Therefore we saved employee hour that is spent on finding solution to internal problems to seconds which were prolonged to days before chat-bot application.

Previously, a team of 30-employee met and answered the call records that the employees had opened for their problems. There are 70 thousand call records per month. It takes a certain amount of time to answer them. Because the chat-bot has been learned from the existing data, the team of 30-employee is shrunk by 70% due to the instantly given responses by in-house problem management platform. These people have served in areas with high value.

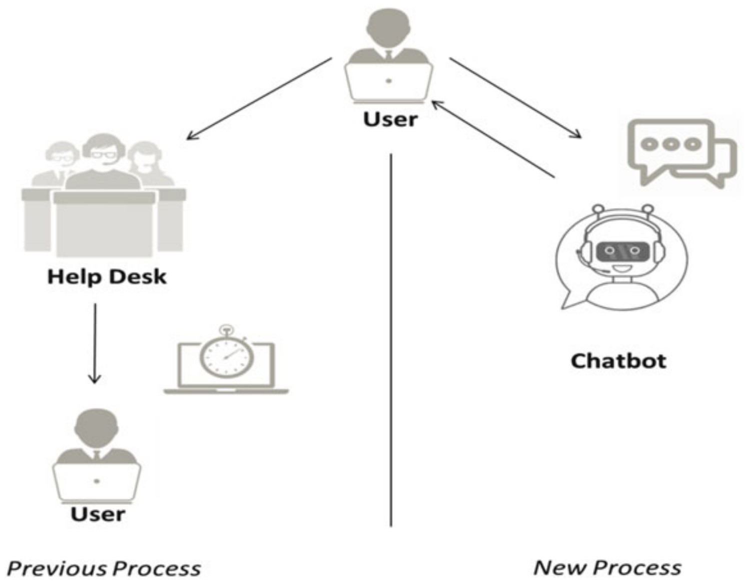

Fig. 1.8 Previous and new processes of problem management

It is expected at the end of the year, chat-bot will be available to be positioned to our customers through different channels. Therefore, our customers' daily banking transactions are aimed to be provided by chat-bot support.

1.6.5 Recommendations for Robotic Process Automation and AI Projects

Experience is such a valuable thing that cannot be learned from statistical analyses or structured Manuals or documentations. We are living in a world that everything becomes open since openness is the simplest way stimulating new ideas to be created. Therefore, the lessons from our own experiences can be listed as follows;

- Be sure to evaluate your processes before you get into robotic process automation, complete simple improvements that will be improved and simplified
- Manage demand from business process owners. RPA should not be the default answer. Calculate current costs for solutions that are presently in use and consider which will be eliminated by the implementation of the RPA strategy.
- Robotic process automation should be considered as a digital workforce that works 24/7. It is necessary to plan this period well in order to obtain continuous efficiency. Make and track the daily work plans of your digital employees.
- Establish a central team to monitor your employees. This team should always follow the results of the study and plan the daily work schedule.

- Promote your RPA project well within the organization, ensuring that all units benefit from the benefits. Thus, the process of determining the processes carried out manually will be accelerated.
- Be prepared for the negative reactions of employees. The RPA can be seen as a threat to the employees. Establish your communication correctly. Ensure that the threat is not perceived as an opportunity. Inform your employees about how to use automation and how RPA tools work.
- Monitor new automation trends continuously. RPA projects will also disappear with new opportunities.
- Find people who can see automation opportunities and contribute to the development of these skills.

1.7 Conclusion

This article discusses the transformation of business models in the digital age of financial institutions through robotic process automation and artificial intelligence. In the digital age, it is inevitable for the financial institutions to transform their business models when customer expectations are transforming and opportunities for cost optimization are rising. This development forces organizations to change in many areas from customer processes to internal processes. The areas that need to be transformed to achieve competitive advantage by adapting to this development are evaluated. Although the need for human beings in operational jobs is reduced by automation and artificial intelligence and, the need for knowledge workers will continue with new skills and fields of work. The transformation of organizations is only possible with the transformation of skills. Institutions must integrate these two evolving technologies into their processes and should not skip the organizational transformation.

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Chapter 2
Human-Robot Interaction in Organizations

Ayşegül Özbebek Tunç

Abstract As advancement in technology is on the rise in organizational setting as observed in other areas, human-robot interaction is getting more focused in both academic and practical studies. Social robots influence business life deeply and hence human life by changing organizational settings. This study aims to explore how the interaction between humans and robots affects the workplace and in what aspects we can explain the nature of sociality and collaboration with robots. It also aims to put forward advantages and disadvantages of human-robot interaction by presenting essential reference points and discussing many aspects of human-robot interaction in organizations.

2.1 Introduction

Human-robot interaction has recently pointed out in academic research papers as well as in the practice in the fields such as robotics, posthumanism, cognitive psychology, design, engineering, etc. As practices and processes of Industry 4.0 have implemented in the organizations, the interaction between humans and robots become more usual, more practical and more experienced. In this context, it is vital to understand how robotic work partners affect workplace, which has been comprised of humans until now.

It is possible to see the robots in any organizations such as hotels, restaurants, retail shops, airports, etc. For example, humanoid service robots are designed to deliver service and interact with humans as their primary characteristics. Today Marriott, one of the biggest hotel chains, uses service robots for room service. On the other hand, Nestle provides sales service via service robots in the shops (Stock & Merkle, 2018). As these examples become normal and more apparent, not only practitioners (designers, engineers, data miner, etc.) but also academics who study

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on robotics science, psychology, organizational sociology, culture, etc. become interested in robotics field.

In this chapter, firstly the nature of intelligent systems will be explained and in this context the approach of machine learning will be mentioned. After that, it will be stated what differences between human and robots are and how the gap is closing today through integrating robotics science with other sciences such as neuroscience, psychology, cognitive science, development psychology, etc. Then, human-robot interaction will be set forth with many aspects and finally what working with co-worker robots (co-bots) brings for humans and organizations in a different setting.

2.2 The Nature of Intelligent Systems

While years ago robots were generally big in physical appearance and only one-task oriented in terms of competence, today intelligent machines are designed with multi-task oriented to collaborate with humans in the workplace and are used to even in small enterprises (Davenport & Kirby, 2015). Robots already have social roles in the organizational setting as teammates, co-workers, subordinates and so on.

Machines capable of performing cognitive tasks are more important than machines capable of doing physical work. Thanks to modern artificial intelligence, it is now possible to produce these machines. Our digital machines have begun to demonstrate their ability to break the chains that restrict them, to recognize patterns, to communicate in a complex way, and in other subjects that were previously monopolized by humans. It is not surprising to see that numerous artificial intelligence elements will either work on behalf of humans or take place in the background (Brynjolfsson & McAfee, 2015).

As a new direction for intelligent systems, there are some efforts to create artificial emotional characteristics for robots to get human-robot interaction better. A project titled as Artificial Emotional Creature was conducted by MIT Artificial Intelligence Lab and its main purpose was to produce a pet robot who had artificial emotions. In this project, it was developed through the integration of vision and audition, using the interaction of a human being with the robot as the training reference (Shibata & Irie, 1997).

Social and organizational theorists need to address what will happen to organizational issues when intelligent robots come to organizations. For the framework for social and organizational theorists, four paradigms are suggested from organization science. Structuralism, social networks, information process theory and contingency theory can be grounded to form a new organizational form with intelligent systems (Carley, 2002). In that case, the design of organizations should be revised according to complexity coming from the presence of intelligent robots.

The results of Carley's study (2002) propose that the increase in access to human and knowledge demonstrate a tendency to expand the time to acquire the most appropriate knowledge and to diffuse any part of this knowledge as human are engaged more in intelligent systems such as robots, artificial neural networks, applied algorithms, etc. in organizations. In addition to this, it is seen that performance is affected more negatively by the increase in the available knowledge in comparison to the rise of communication participants. Actually, it is a logical expectation about that the body of knowledge is getting expanded in comparison with humans in total.

Some factors such as data storage and digitalization of all data can play a role in presence of smart agents in organizations. According to Carley (2002), the important difference between use and access of information should be understood and properly differentiated from each other because the results surprisingly show that having more information in the hand makes the amount of access and learning of the information slower. Both people and smart agents have limited abilities to learn the information exactly. This is a sign of the dilemma for information expansion and information access.

On the basis of Carley's (2002) study, we can say that robots (avatars) are more serviceable in large organizations rather than in small ones because people are more open to communication in small groups. Actually, large organizations may be available for robots because much more workforce means a greater amount of communication so that robots can learn more than in small organizations. On the other hand, smart agents which cannot learn as expected can surprisingly communicate better among people. This is like databases becoming ineffectual in larger populations as they continue to alter and develop in matter.

As mentioned earlier, one of the most effective methods of digging the valuable information out of the big data is machine learning. In this technique, the computer processes and mines the data presented for it and it creates its own program according to the statistical relations discovered in a sense. Machine learning usually consists of two steps. Firstly, an algorithm is developed according to known data; then, it is asked to solve similar problems for the new information. Moreover, as new samples are getting inputs for the system, it can improve itself and adapt to the new environment and conditions (Ford, 2018).

Today one of the most striking examples of machine learning is Google's translate application. The algorithm of Google Translate is on the basis of 'rosetta stone' approach and examines and compares the millions of pages of texts which are translated into different languages. Firstly, Google team applied official documents prepared by The United Nations as data and then the team used documents translated into different languages that Google search engine found over the Internet. As a result, Google has created a wider range of language models than those created in human history so far (Ford, 2018).

Self-improving systems, on the basis of machine learning, are also new way of advancing artificial intelligence. Self-improvement of the systems lead to unpredictability of behaviors of intelligent machines (Omohundro, 2007). Today these systems may be very practical for humans as they are controlled by humans. Otherwise, for the future, learning machines will be perceived as threats for human because it is difficult to foresee the future of these systems.

2.3 Human Being Versus Robot Being

Intelligence is considered as the most important difference between humans and machines. However, today this gap is slowly closing between them by means of advancements in robotics science. Robotics science is contributed by several disciplines such as neuroscience, psychology, human sciences, cognitive science, engineering, computer science as well as technological developments such as artificial intelligence, machine learning, presence of big data, etc.

2.3.1 A Mixture of Human Sciences and Robotics

In their study regarding humanoid and android science, Ishiguro and Asada (2006) highlight that human anthropomorphize robots to communicate and interact well with them. They also emphasize the importance of appearance and behavior for interactive robots; on the other hand, they indicate that robotics science focus mostly on technical issues, not behavioral ones. According to the authors, developing and using a human-like robot (android) are getting easier to study related to the interaction between humans and robots. This contributes to not only robotics science but also cognitive science. Developing humanoid robots requires the accumulation of knowledge from sciences regarding humans such as sociology, psychology, social psychology and so on. In a similar way, the field of android science is formed by contribution from different disciplines like engineering and cognitive science. In the framework of this field, android robots can share information with humans by taking advantage of both robotics engineering and cognitive science. For better interaction between human and robots, it is substantial to understand conscious and unconscious identification of humans and then design robots according to human-like hardware and software. This effort is handled under the 'humanoid science'.

Synergistic intelligence, one of essential concepts regarding humanoid and android science, means 'intelligent behaviors that emerged through interaction with the environment, including humans' (Ishiguro & Asada, 2006, p. 75). It presents the effort of exploring humans in a new way and a new understanding designing humanoid robots supported by interactive feedback between humanoid robots design and human science. Synergistic intelligence also necessitates self-developing characteristic for robots.

Cognitive robotics aspires after creating framework to engage human cognitive abilities to robots. The way of thinking enables robots to be better-designed according to humans' cognitive abilities. This means that a robot is equipped by more cognitive abilities such as making rational decisions, setting up plans, respond reasonably to unexpected situations and issues, and adapting to changing factors as well as having flexible and self-developed behaviors (Thielscher, 2006). These competencies can also foster the interaction between humans and robots.

By being inspired from other disciplines of ethology, neuroscience and psychology, Velasquez (1999) tried to integrate robotics sciences with these fields and developed a computational framework. The researcher aimed to develop a model comprising significant viewpoints of emotional processing and combining it with perception, motor control, behavior and motivation models. In the study, it is thought that the main purpose is to be able to control various autonomous systems such as a robot which can express feelings.

2.3.2 Integrating Human's Social Abilities into Robots: Social Robots

Robotic technology has grown rapidly and robots take place in organizations. As a new type of intelligent robots, social robots are robotic machines that play social, assistive or therapeutic roles (van Oost & Reed, 2011). Breazeal (2004) defines a sociable robot as 'is able to communicate and interact with us, understand and even relate to us, in a personal way' (p. 1). Persson, Laaksolahti, and Lonnqvist (2002) use the term 'socially intelligent agents (SIA)' instead of social robots to draw attention to the nature of social intelligence and believable social interaction by making sense of real, fictive or artificial social settings.

Bartneck and Forlizzi (2004) define a social robot as 'an autonomous or semi-autonomous robot that interacts and communicates with humans by following the behavioral norms expected by the people with whom the robot is intended to interact'. On the basis of their own definition, they classified social robots and proposed a framework in terms of form, modality, social norms, autonomous and interactivity. According to the framework, some guidelines were revealed as a result of the study. For example, the social robot has such a form that is compatible with skills. It also should manage the communication flow with humans by using mimics like humans. Finally, the social robot should recognize the social rules pertaining to humans and improve several behaviors to meet the humans' sociality needs.

According to Steuer (1995), people act more responsively across to robots as they have some special characteristics similar to themselves. He asserted that there are five properties which makes human-robot interaction easier. They are human social rules, human-like physical appearance, interactivity, human sounding speech and natural language use. It is suggested that people use social behaviors and norms when interacting with robots.

For the purpose of evaluating social robots' social effectiveness, Steinfeld et al. (2006) determined metrics such as interaction characteristics, persuasiveness, trust, engagement and compliance. These metrics are respectively presented to assess the interaction style, behavior or attitude change, reliance, efficacy several social features, and cooperation.

In another study, Claure and Jung (2018) aimed to understand social dynamics existing among human-robot teams and conducted the robotic social attributes scale to 30 participants. The scale measures warmth, competence, discomfort, arousal, and performance of the robot perceived by human participants. It is clearly understood that people have different expectations regarding robots. To determine these expectations and to design robots in a way to meet the needs are very critical to place human-robot teams in an organization or any structure.

In her short paper titled 'Human-Robot Partnership', Breazeal (2006) from MIT Media Lab indicates that her favorite science fiction robots are the ones having social abilities because they facilitate human life. In her own words, social robots, as a new type of intelligent robots, must be 'natural and intuitive enough for the average customer to interact and communicate with human, work with as partners, and teach new capability' (p. 79).

On the basis of Breazeal's thoughts (2006), there are some challenges in regards to social robotics. First of all, robots who have social cognitive skills should understand humans in social-psychological concepts to value the objectives, beliefs, emotions, drivers, and all mental forms which explain basic reasons for human behaviors. The second one is robots' collaboration with humans as work partners. For effective collaboration, robots should behave on the basis of human social rules such as communication, participation and so on. Lastly, social robots are like social learners that learn from people. Social learning for robots is a process that includes learning new abilities from human partners, imitating human behavior, engaging the social processes like humans and so on.

Mataric (2006) seeks for an answer to the question 'what happens when intelligent robots and people share an environment and even goals?' (p. 81). The field of human-robot interaction may help to shed light on this question. For the first step, socially assistive robotics are suggested to overcome current issues in interaction between human and intelligent robots because they aim to help people socially, especially rehabilitation, training and education, in comparison to the physical needs. The robot's physical incarnation is critical to bring forth the quality of the human's reaction, not only in the theoretical studies but also practices. Characteristics and implementations of the incarnation provide more ways for research into both humans and interaction between humans and socially assistive robots. For example, it is very critical to explore how the robot looks, how it behaves and how it relates to the environment (Mataric, 2006).

Humans do not have hopes in regards to presence of sociable robots. The other side of the coin humans' fear from them. Deception and substitution are two important fears which humans have. The first one may become dangerous for mentally impaired elders and toddlers as robots have emotional believability. Secondly, humans assume that robots will take over jobs and lives belonging to them and replace them in all settings (van Oost & Reed, 2011).

Scassellati (2000) introduces that two main ideas which contribute to the intersection area between the fields of human development and artificial systems. First, developmental models regarding human beings can significantly contribute to the building of robotic systems which comprise of not only physical requirements such as robots, appearance, etc. but also perceptual and cognitive abilities. Second, these systems can be applied to understand and assess the models just like simulation researches are conducted to measure cognitive models. According to Scassellati (2000), models from developmental psychology frequently present 'behavioral decomposition and observations about task performance which may provide an outline for a software architecture.' (p. 1). For that reason, studies in regards to human skill advancement can be suited to determination of robotics systems. On the other hand, robotics, especially humanoid robots, can also lead to improvement of developmental psychology via exploring the nature of human intelligence more.

Tapus and Mataric (2007) study on the emulating and embodying empathy in socially assistive robots and how it is applied functionally. For this, authors determine four elements which a robot should have. These capabilities are recognizing, understanding and interpreting the other's emotional state, processing and expressing its emotions by using different modalities, communicating with others and perspective taking. Then, authors measure the empathy in robots with these components: empathic concern, perspective taking, fantasy and personal distress.

2.4 Human-Robot Interaction

Although robotics is a wide discipline, the efforts which can determine the human-robot interaction as a field have clearly been seen in the literature review since early 1990s. According to the definition by Goodrich and Schultz (2007, p. 204), 'human-robot interaction is a field of study dedicated to understanding, designing, and evaluating robotic systems for use by or with humans'. To explore a human-robot interaction survey, Goodrich and Schultz (2007) define problems of human-robot interaction in terms of autonomy, information exchange, teams, task shaping, finding a unifying theme and adaptation, learning and training and classify the types of human-robot interaction in terms of being collocated as remote interaction and proximate interaction (Goodrich & Schultz, 2007).

Kiesler and Hinds (2004), the most cited researchers studied on human-robot interaction, have highlighted some reasons why this field differs from human-computer interaction. The first reason for studying human-robot interaction is that humans perceive robots differently from other technological devices. Especially for the effort of getting robots more 'anthropomorphic', researchers are encouraged to understand which mental systems are appropriate for better human-robot interaction. Secondly, reactions and interactions differ in comparison with other computer technologies because of mobility and flexibility of robots. They have complex feedback mechanisms to respond variously to their users. The third one is machine learning abilities of robots. It is possible to say that both disciplines of human computer interaction and human robot interaction broadly study a sociological understanding of robots which accompany people.

The increase in studies in this field brings along new research questions and contradictions. For example, while scientists believed that human beings could distinguish only universal and basic emotions in previous years, today psychologists describe much more emotional distinctions to use in robotic design. This change is rooted in new and radical technological improvements such as machine learning, data science, etc. (Kiesler & Goodrich, 2018).

Human-robot interactions can push people to acquire strong feeling connections to robots. There is an assumption that if robots appear like humans, humans will treat them as if they were humans. These emotional embracements create human-robot involvement in the group. The engagement of robots in the organization and involvement as team members change the beliefs which were valid until today about human groups (Robert Jr & You, 2014).

Shibata (2004) studied human-robot interaction by comparing industrial and service robots and discussed whether every type of robot has interaction ability with humans in respect of their functionality. He presents a review including the nature, duration and psychological enrichment of human-robot interaction and some cases from several cultures.

Arkin, Fujita, Takagi, and Hasegawa (2003) examined human-robot interaction on the basis of ethological and emotional aspects. For the effective interaction, they suggested focusing on more motivational factors and then attain a greater ability which links between humans and robots. They also set forth that more natural human-robot interaction will be designed and emotionally grounded concept will be a key variable to understand the robots.

Sung, Christensen, and Grinter (2009) investigate the novelty effect in human-robot interaction and explore how long term use of robots affect the interaction by using a longitudinal field study including 30 households. The results indicate that human-robot interaction is stable enough especially in the first 2 months when human and robots have met. The second important result is that humans are becoming bored with interaction if the task is routine. The other result showed that human expect more creativity tasks from robots to be able to keep interacting with them well.

2.5 Working with Co-worker Robots (Co-bots)

How does technology, in particular robots, impact work life and organizations? Acceptance and carrying out of workplace technologies are affected by some concerns. One of which is on the basis of user friendliness of them. This characteristic affects directly the performance of people and drives the interaction between humans and technology. The other consideration is self-efficacy felt by people. As they have ability to use technology and experience the functional benefit of technology, they become open to new technology. The third concern is about being economical and low-cost of technology. New technology is getting more implemented by individuals as long as it provides benefit to the organizations and people. The last consideration is the role of social factors. If new technology is accepted by their social environment, people are having more willingness to adapt to it (Cascio & Montealegre, 2016). These factors have the importance of putting technology to organizations and then the process of providing to be accepted, adopted and performed by individuals. In a similar way, adoption to robots and collaboration with them in an organization have the same concerns for working people.

Redden, Elliott, and Barnes (2014) create the term ‘co-bots’ for co-worker robots who are team members working with humans in an organization. They have related competences with given jobs and significant roles in capacity of industrial organizations. Further to that, they are becoming social actors to the degree that they collaborate and harmonize with human. Today human resource management processes and tools such as work analysis, training and performance development are becoming valid for robots, too. In addition to this, motivation and teamwork are concepts that are expected by robots as well as humans (Coovert & Thompson, 2014). These developments and foresights bring to our mind the question how the future of organizational commitment, organizational citizenship behavior, work satisfaction, group behavior, trust, teamwork and similar concepts will be for co-bots.

As a teammate, robots should be accepted by humans so that humans interact properly with them, improve common mental and communicational models for interaction with robots, and develop trust relationships with them. As robots have more autonomous jobs, the need of humans equally decline and robots continue to learn the job more via machine learning (Cascio & Montealegre, 2016). In addition to this, the fear of job loss is another concern which humans face regarding the use of robots in the workplace. Blue collar workers may see them as rivals and show resistance to their existence. They are perceived as threats by white collar employees as well, especially finance and accounting tasks. On the contrary, some jobs will be still on people’s hands and they will continue to show success without the need of robots’ automation world. Davenport and Kirby (2015) assume that knowledge workers can accomplish some jobs which they and intelligent systems do not separately perform but they do with the cooperation with each other. Despite this difference of opinions, it must be known that human resources management tasks such as job analysis, job design, workforce planning, recruitment and staffing, training and development, performance management, compensation management and career management should be redesigned to meet the robots appropriately in an organization and manage the relationship between humans and robots.

In human-robot interaction context, it is vital to understand how robotic work partners affect the workplace which belonged to humans until now. Researchers studied some concepts such as trust, responsibility, guidance, design, etc. to catch clues for better collaboration between humans and robots. For example; it is expected that behaviors, cognitive abilities and appearances of robots affect human-robot interaction. A robot may look mechanical, animal or human. On the basis of this discrimination, the type of basic robot designs are respectively mechanoid, zoomorphic and humanoid (Dautenhahn, 2013). It is argued that humanoid robots will make the human-robot interaction better and present a more involved interplay in some studies (Breazeal & Scassellati, 1999; Brooks, 2002). So, it is suggested that users should be engaged in the design of robots and then understand their roles and functions for a contribution to human-robot interaction (Dautenhahn, 2013).

It is clearly seen that some robots, especially humanoid robots rather than machine-like robots, are better at collaborating more naturally with humans. In this case, humans depend on them and allocate responsibility in terms of using authority. Hinds, Roberts, and Jones (2004) shed light how physical appearance and relativeness of robots affect human-robot interaction in terms of willingness and responsibility taken by humans.

Their approach to accept new technologies affects people's degree of openness to work with robots (Hinds et al., 2004). In other words, being more engaged in new technologies and following them regularly render people more coherent with robots and more eager to collaborate with them. In the same way, Mutlu and Forlizzi (2008) investigate how organizational factors are affected in a hospital which uses robots. They assume that the more sensitive to social dimension the technology in the organization, the more negatively humans react and the more resistance they have. In addition to this, it is stated that sense-making in technology adaptation has an important role in human-robot interaction in organizations. The results of the study indicate that there is a difference between different units in how people incorporate the robot into their workflow and their perception and interaction with the robot. The authors developed a model demonstrating workflow (staff interruption), political (goals, interests), social/emotional (emotional tone of social relationships) and environmental (traffic and clutter in the environment) dimensions on the basis of patient profiles.

Hierarchy is one of the important dimensions of an organizational structure to understand who has power in the organizations. Hierarchy also brings about a couple of concepts such as authority, autonomy, span of command, etc. These concepts are undoubtedly critical when explaining how human-robot interaction is realized in organizational as well as social life. People's sense of responsibility about their work depends on their position (leader, supervisor, manager or worker) in the workplace. Here responsibility is the cumulative feelings of performing well on the task, ownership for the task and contribution to the task. According to Sande, Ellard, and Ross (1986), people at upper echelons see themselves as more adequate and more responsible for the task which they have to do. This is about being human, but working with robots or managing robots does not have the same behavioral environment. Upon this difference, Hinds et al. (2004) assume that people depend more on the robot partners and assume less accountability for the task when working with robots that are supervisors as compared with robots that are colleagues and subordinates.

Stock and Merkle (2018) examined the performance of humanoid service robots in comparison to service employees on the basis of role theory and expectancy disconfirmation paradigm. They also investigated how social robots' artificial innovative behaviors (facial, vocal and bodily) revealed different human-human (employee-customer) service relationship and how they affected the service performance. Their study (2018) presents comparable knowledge by describing a real work life problem in organizations and conclude that customers are positively affected by innovative behaviors of robots.

The presence of robots in organizations have changed how groups work in real life and brought new socio-technical problems between humans and robots (Robert Jr & You, 2014). In this context, the questions about how a robot discusses with human in a group work, realizes communication with humans and understand each person in the team are questions which come to the mind. The inclusion of robots may be an advantage or disadvantage for the team effectiveness. In addition to this, trust among team members may be affected negatively by depending on the numbers of robots in the actual team. We have limited knowledge and experience about all possible challenges because of the lack of practices in regards to human-robot interaction in real life so far.

2.6 Discussion

Due to the nature of human-robot interaction structure, a question comes up. What is the future research questions of this field? According to Kiesler and Goodrich (2018), there are many concepts that are needed to learn and study deeply. Some of them are humans' intentions, trust, cultural aspects, contribution, benefits or harms in regards to robots. On the other hand, advances in new algorithms, development in cognitive robotics, machine learning practices should be followed and considered when assessing the interaction between humans and robots. In addition to this, it is important to know how to catch the mutuality between human and robots in terms of sociality.

The measurement of how the human-robot interaction is crucial to get better design of robots and to be more harmonized with humans. The question which capabilities, functions and tasks that robots have while working are a necessary knowledge which should be answered for not only human-robot interaction but also interaction among robots.

Another important subject regarding human-robot interaction is non-accountability of robots to the human. For this, a law system is needed independent from states, cultures, diversity of human, etc. The dilemma is open to question.

Human beings may perceive the existence and potential of robots as threats for themselves. Cascio and Montealegre (2016) assume that various jobs which belong to humans will be performed by intelligent robots in the next 5 years. It is expected that this will change the actual economical understanding not only in separate economies but also as a whole global economy. It will also alter the structure of organizations, labor economics, organizational sociology, etc. by bringing breakthrough changes and challenges of all mechanisms in the world.

Actually the critical point is having a new technology in an organization. The main issue is how the implementation process of new technologies (in particular robots) is performed by considering psychological and human factors of the organization (Coovert & Thompson, 2014).

Many stakeholders question the power in their hands when robots are becoming involved as a part of organizations. Power in organizations is always critical to determine who are main actors or top decision makers. The change of the balance between autonomy and authority affects surely not only technical factors but also social factors such as commitment, power, authority, communication, conflict, collaboration and so on. All of these factors also influence the decision making process in organizations because of change of control.

It seems that the big data will have two very important results for knowledge-based professions. Firstly, in many cases, the data accumulated before can lead to direct automation of given tasks and works. Just as humans firstly examine the old records and then practice by trying to perform certain tasks when learning a new job; so too can the intelligent algorithms can successful in many samples by using the similar approach. The second and more significant impact of big data on knowledge-based jobs is about the ways of managing companies. Big data and estimation algorithms have the potential to reduce the number of knowledge-based jobs as well as changing the way of performing them. Human skills such as experience and reasoning will be replaced by predictions derived from the data. As top managers use data-based decision making algorithms more frequently, the need for a workforce including analysts and managers will be limited or decreased over time. Today, the knowledge workers of companies present their analysis with the information they have collected to the different levels of the managers. However ultimately, a single manager and a strong algorithm may implement more efficiently in such an environment. It seems that companies will be getting flat in the future compared to today. Middle managerial level will be eliminated and most of jobs which are performed by experts today will evaporate in the near future (Ford, 2018). These prediction about big data and of course the presence of robots will surely affect it.

As future directions, it is possible to say that we need theories to understand and explain human-robot interaction in groups and in organizations as a whole. Apart from traditional research designs, we can produce new ones including experiment, observation and simulation-based to study social drivers and team issues in human-robot teams. New robots can be developed more cheaply and more observably to test the human-robot interaction in organizations, so that new forms of robotics design are suggested for better human-robot interaction. We need studies which focus on the socio-technical issues (technical competences and social roles and norms) to make team collaboration, team coordination and team communication better in human-robot groups. To create a common framework, social and technical requirements should be considered and examined together. This provides not only thinkers who theoretically study on robots and human-robot interaction but also practically robot makers.

It is also essential to explore the difference between knowledge based workers and physical ability based workers in terms of their orientation to smart robots. In addition to this, pearls and pitfalls of the robots embedded in the organizations and working with human should be investigated in terms of group processes. Moreover, it is worth doing research about how team dynamics such as trust, cohesion and collaboration and the group performance vary from human-human groups to human-robot groups. All these research questions can be designed as a new research which contributes to and enriches the human-robot interaction field.

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Chapter 3
Internet of Things in Blockchain Ecosystem from Organizational and Business Management Perspectives

Songül Zehir and Melike Zehir

Abstract This chapter focuses on Internet of Things (IoT) in blockchain ecosystems. IoT is a technological paradigm that bridges physical and digital worlds over a global network. There are a number of major challenges such as privacy and security. Blockchain can be a solution to these problems. In the literature, the subject is mostly discussed from technical and technological points of view. In this chapter, the topic is examined in a comprehensive manner including organization and business management perspectives. The chapter will begin with a comprehensive overview of IoT. Key features, different perspectives, developments and challenges about IoT will be described. The next section, blockchain based IoT as a solution to major challenges of IoT, will be explained. The relationship between IoT and blockchain will be described. Advantages of using blockchain for IoT, areas of usage, barriers and recommendations will be presented. Section 3.4 will be on its impact over businesses. Section 3.5 is devoted to emerging trends and future areas for research. The last section will conclude the chapter. Through the publication of this chapter, it is intended to be contributed to the literature on the Internet of Things and blockchain ecosystems. The chapter is expected to foster the research activities on the subject integrating organization and business management studies.

3.1 Introduction

Internet of things is the term given to network of devices connected to each other globally. These devices are reacting to their environment by interacting with each other to achieve common targets (Atzori, Iera, & Morabito, 2010). The main purpose of IoT is to share information in real-time and effectively (Yang, Yang, & Plotnick, 2013). The devices can communicate over internet with computer and other devices without

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the need of human intervention (Fleisch, 2010; James, 2012; Zanella, Bui, Castellani, Vangelista, & Zorzi, 2014). It also can be monitored and controlled remotely. Thus, human and devise can exchange information in real-time (Baldini, Botterman, Neisse, & Tallacchini, 2018; Man, Na, & Kit, 2015; Guillemin & Friess, 2009). Through internet of things, humans and devices are connected with everything, at anytime and anywhere. This connection can be taking place over a network or a service (Guillemin & Friess, 2009). Real-time data analytics, machine learning, product sensors and embedded systems extended the exploitation of IoT (Wigmore, 2014). Moreover, wireless networks, control and automation systems also contribute to IoT.

IoT has got an increasing importance in recent years, while technology revolution is taking place and smart technologies are becoming more and more integrated to our lives. However, there are major concerns about privacy and security. Blockchain can be a part of solution. Therefore, blockchain is particularly recommended for IoT applications, where privacy and security risks are highly concerned.

Markets and industries are facing massive changes with the integration of IoT. New economies, markets and business processes are being developed. Customer needs and expectations are radically changing. Organizations should develop new strategies to cope with these new challenges. In this new era, software industry and IoT applications gain importance. Data has become the most important feedstock of this new age. Consequently, mining and storage of big data have emerged as an important need, while cloud computing has come into prominence.

This book chapter provides a comprehensive framework about IoT, including its development, implications and pioneer companies and products in the market. Challenges are explained, presenting blockchain as an emerging technology to cope with privacy and security problems. Blockchain and IoT relation are described, presenting their areas of usage. Following these, their impact on businesses and organization is discussed. Big data, cloud computing and marketing 4.0 are explained as emerging concepts within this period.

3.2 Overview of Internet of Things

3.2.1 Development of Internet of Things

The inventor of the term IoT is Kevin Ashton. He is one of the founders of Auto ID Center established within MIT in 1995 (Ashton, 2009). Although the term is firstly used in 1999, it has become popular more recently. This is mainly due to limited address capacity and speed of internet by the end of 1990s, when wide use of IoT would cause reaching to the limits of devices connected to internet. This problem is solved with transition to Industry 4.0 age and use of IPv6 protocol vastly extending the capacity of available internet addresses.

Although IoT is a recently used term, its origins date back to invention of telegram. Development of telegram in 1830–1840s enabled communication of machines. In 1950s, computers are introduced. Shortly after, in 1962, Arpanet is developed within the body of US Ministry of Defence. Arpanet allowed several devices to communicate with each other over a shared line. It is the first data network and the pioneer of world wide web. Starting from 1980s, public use of Arpanet is supported, opening the way of today's internet. In 1990, the first digital radio broadcast using sound cards of computers is realized. In 1993, GPS is tested. Satellite systems and communication infrastructure of GPS provide the needs of IoT communication.

According to Cisco Internet Business Solutions Group (IBSG), IoT was born in 2008–2009. They state that at these dates, the number of devices connected to internet exceeded the number of internet users.

IPV6 which provides the greatest advancement in IOT's development, is today's network addressing technique. Its development dates back to the beginning of 90s by IETF (Internet Engineering Task Force). Every device that connects to internet needs an IP address. IPV6 is the last version that substantially increased the assignable address combinations, enabling development of more effective IoT applications. IP protocol provides authentication and location for devices on the network and directs network traffic.

One of the most important factors in the improvement of IOT is the development of cloud technologies. Cloud technologies offer an area that is always active and low-cost to store the data and make calculations. Thanks to the cheap and high access cloud infrastructure, storage and processing load on IoT devices is easily transferred to cloud servers.

IoT grows rapidly. It is estimated by Cisco that approximately 50 billion objects will be connected to the internet by 2020 (Evans, 2011).

3.2.2 Implementation of Internet of Things

The first field implementation of IoT was with a drink vending machine at Carnegie Mellon University, in 1982 (Farooq, Waseem, Mazhar, Khairi, & Kamal, 2015). By connecting to the machine over internet, it was possible to check the remaining products inside and the temperature of the drinks. From 1993 to 1997, many companies offered products and services similar to Microsoft's at Work and Novell's NEST. The first product in this field was internet refrigerator named the Internet Digital DIOS. It was developed and released to market by LG in 2000. Because of high prices, customers were not interested in the product and it failed.

Today's Iot's products are more successful thanks to developing technologies and decreasing costs. We are using these products in many areas of our lives. For instance, Hapifork, a smart fork warns its owner in case of fast eating or overeating helping for a proper diet. Another example is the smart ball of Adidas, providing you several statistics like how many penalty shots you have scored, how much the speed of your kicks was and how many goals you have scored with each of your feet, through an app. There is a distinctive example that Edyn developed for gardens. It provides you recommendations about what and how you should plant together with irrigation frequency.

3.2.2.1 Examples of Companies and Products Using IoT

The examples given in this subsection are based on a report (AIG, 2017).

IBM Cloud Business Solutions Several companies are using IBM Cloud Business Solutions. As an example, IBM was partnered with Whirlpool to use IoT in home sector in 2014. This partnership allowed Whirlpool to use IBM Whatson IoT Cloud. By this means, high speed data flow from devices could be analysed rapidly and specialized services could be provided to customers. General patterns of customers can be identified while they are using their devices, fine tunes can be made in settings and supply chain can be optimized. Watson IoT Cloud allows real-time access to multiple data resources for early estimation of possible problems, improve quality and customer satisfaction, while reducing maintenance costs.

Ericsson Maritime ICT Cloud Platform The Maritime ICT Cloud is developed by Ericsson, providing sea transport organizations to connect to an integrated platform together with their ship fleets. Sensors provide many useful and valuable information from location and speed of a ship to chilled cargo temperature in real-time, to transportation companies and producers. System not only tracks the cargo and the ships, but also allows all the stakeholders (from producer to buyer) in the sector to gain and analyse data in real-time. Maritime ICT Cloud also connects several systems for maritime, used for motor and hull-monitoring with bridge communications to reduce inefficiencies, risk and total costs. Through satellite technology allowing communication from sea to ground, stakeholders can take decisions and actions to improve the comfort of crew, protect transit goods and route efficiently.

Daimler Car2go Daimler partnered with IBM to gain the technological expertise and tools to make their smart automobile fleet car2go successful. Through sensor and wireless communication, performance of each car can be tracked by the company, data analysis can be done to improve efficiency and a network of accessible vehicles is provided to customers. Customers can get or book in advance one of the nearby cars of car2go network. This flexible service allows customers to easily use a car whenever they need it, without purchasing one or paying for parking place.

U.S. Bank U.S. Bank pioneered many new technologies in the finance sector from ATM's to branchless banking. It is one of the first companies that tested contactless payment technology and it was very successful at applications like mobile cheque payment, mobile bill payments with photo, mobile credit card balance transfer. U.S. Bank innovation team works on IoT technologies. One of their studies is autonomous vehicle embedded financial system. For example, a vehicle can go to the service itself and make payments if connected to its owner's bank account.

ABB Group ABB Group as one of the leaders of energy and automation technologies, aims to use IoT for maintenance services in heavy industry. Wide use of automation technologies brought together tracking and maintenance problems. Previously, ABB Group was sending technicians to the field to make diagnostics. Now, the company provides many cloud-based IoT solutions such as data collection, statistical analysis and individual estimations done through remote monitoring rooms and predictive maintenance analysis. Proactive monitoring reduces the time and effort needed for maintenance works, reducing costs and preventing failures decreasing interruptions.

Microsoft Azure Iot Technology This technology analyses all the sensors and data in included systems, providing technicians real-time diagnostics and rich data visualization. ThyssenKrupp uses machine learning skills of Azure in predictive modelling to prevent technician faults and interruptions. Another energy company that uses this system is Rockwell Automation. Conventionally, oil and gas supply chain requires large and expensive equipment that are open to costly repairs and production interruptions. Microsoft works together with Rockwell Automation to predict equipment failures throughout the supply chain, monitor performance in real-time and improve processes using a wide range of software portfolio, sensors and devices through Azure IoT technology.

OTOY OTOY is a California based company that focuses on not only visualization of data, but also simulation of performance of products, buildings and other devices-object under different conditions through virtual reality technology. Potential areas of use of OTOY technology is architecture and construction. By means of the sensors of OTOY, IoT can collect lighting, wind and temperature data to simulate weather conditions in real-time to give opinion about the different products that are going to be used in projects. It can create models to run real simulations, giving idea about which window material will provide the highest energy efficiency or which products can be used to protect from floods.

3.2.3 Challenges of Internet of Things

IoT is being integrated to human lives more and more every day. However, it brings together some challenges such as privacy and security. They are main barriers in front of acceptance of IoT (Zhou & Piramuthu, 2015). Information privacy concerns belong to four concerns (Caron, Bosua, Maynard, & Ahmad, 2016):

- Monitoring without permission, through which extensive data can be collected about individual's actions and behaviors,
- Uncontrolled data generation and use,
- Insufficient authentication,
- Security risk due to largely collected information

Control of data generation and information security are important aspects in IoT. The other challenges are:

- Standardization:
- Architecture
- Interoperability and integration

- Availability and reliability
- Data storage, processing and visualization
- Scalability
- Management and self-configuration
- Network performances and QoS
- Modeling and simulation
- Unique identification
- Power and energy consumption
- Security and privacy
- Environmental issues

The issues that have been faced so far about IoT should be carefully considered and solved, together with continuous improvements. This will provide more effective and extensive use of IoT in the future.

3.3 Blockchain Based Internet of Things

IoT concept forms a basis for a world in which most of our daily devices will connect to each other, gather information and interact with their environment to automate some defined tasks. Such a vision also requires continuous identity verification, data privacy, security, robustness against attacks.

Internet of Things (IoT) consists of devices that produce and process large amounts of data that require high level of security and privacy. This makes IoT devices one of the main targets of cyber attacks. IoT devices usually have simple hardwares that consume low amount of energy. These devices mainly spend their energy and spare their processing power to their primary tasks and they are not able to meet their own high security and privacy needs. The conventional security methods can be costly and cause IoT devices to consume large amount of energy and exceed their processing capability. In addition to privacy and security issues, another challenge is the large sizes and distributed nature of IoT networks. Blockchain, the technology that supported the first cryptocurrency system, has the potential to cope with these challenges. Bitcoin, as a Blockchain protocol based cryptocurrency system, allowed P2P payments and money transactions without the need of a third entity. The system has high level of security with encryption, allowing two sides to make transactions digitally.

Blockchain constitutes a secure database for the processes of all the users. The main aim of blockchain technologies is to remove the need for mediators and perform processes over a distributed network. Contrary to centralized systems, every peer of blockchain network keeps a copy of the processes in the system or can reach it through cloud. In this way, everybody can reach and check their own process logs. Confirmation of validity provides high transparency.

Blockchain offers secure communication and privacy to Internet of Things (Bahga & Madisetti, 2016). As IoT continues to grow, it becomes the standard way of transmitting location, temperature and many other data using sensors and devices. Usually, these data resources are shared between different stakeholders and devices, used in big data analysis and also monitored rapidly in some critical applications. Blockchain allows all participating smart objects to reach the same information through a reliable and secure way. In addition to data flow management, blockchain is an effective way for business automation and distributed interactions between several remotely located devices in a decentralized way (Christidis & Devetsikiotis, 2016). Until recent times, blockchain was especially used in finance sector. However, it is turning out to be used widely in many other areas. It is a useful method for security and privacy in IoT applications. Every operation is signed by miners before being sent to blockchain network. Therefore, it is impossible to totally imitate or change an operation. Moreover, system can be monitored to provide proof (Conoscenti, Vetro, & De Martin, 2016).

Transparency is a must for maintaining trust. This is the reason of why open source approaches are recommended in new generation IoT systems. It is also noteworthy that, open source code is still sensitive against errors and misuse of likewise closed source codes. On the other hand, because it can be monitored by many users it is less subject to vicious modifications of third parties.

Blockchain is not a preferable option in every IoT application. It is especially needed in the lack of a central reliable mechanism. Similarly, it may not also be needed in case of mutual trust between the parties. Rather than using blockchain, purchase operations can be done through conventional methods such as bank or intermediaries. In conventional data storage processes, if the security is guaranteed and there is no extreme risk of attacks, conventional database applications may be preferred. Blockchain is not the only option to store every collected data. Particularly in rural monitoring applications, where remote communication is costly, data can be collected using a local system.

3.3.1 Areas of Use for Blockchain Based Iot

There are several areas of usage for blockchain based IoT, such as sensing (Wörner & von Bomhard, 2014; Zhang & Wen, 2015), keeping data (Ateniese et al., 2017), identity management (Wilson & Ateniese, 2015), smart living applications (Han, Kim, & Jang, 2017), smart transportation systems (Lei et al., 2017), wearable technologies (Gipp, Meuschke, & Gernandt, 2015), supply chain management (Kshetri, 2017a), cyber law and security (Kshetri, 2017b). Apart from these areas, IoT can also be used for monitoring in agriculture, improving food security and quality and providing effective logistics. Another major and promising area is energy sector (Fernández-Caramés, 2015). Without the need for human and a third party intervention, IoT allows payment of devices to each other. For instance, a device that is connected to a smart plug can make payment for the electricity that it consumes (Lundqvist, De Blanche, & Andersson, 2017). This concept is also called as Internet of Energy (IoE) (Fernández-Caramés, Fraga-Lamas, Suárez-Albela, & Castedo, 2017).

In health sector, IoT is particularly suitable for monitoring applications. Medicine procurement system can check if the incoming data values are in allowed limits and transfers to blockchain through sensors (Bocek, Rodrigues, Strasser, & Stiller, 2017). IoT is expandingly used in smart cities, industrial processes, telecommunication, defence industry, industry 4.0, financial transactions. It is also used for management of big data. In order to improve security of big data acquisitions and control, blockchain based solutions are proposed and preferred.

The first blockchain solution-based IoT platform was developed by IBM in 2013. This platform is named as ADEPT (Atzori et al., 2010). Through this platform, IoT devices can independently define their roles, responsibilities and permissions, in addition to making transactions and complex negotiations. Guardtime and Intrinsic-ID allied for blockchain-based IoT. Intrinsic-ID provides encryption and ID recognition of embedded devices in big financial transactions and protection of critical data of governments. Guardtime provides Keyless Signatures Infrastructures (KSI) platform as a security solution (Balte, Kashid, & Patil, 2015).

3.4 Impacts Over Organizations and Businesses

3.4.1 User Expectations

From the standpoint of users, three aspects come to the fore about IoT. These are, perception of users and product design, acceptability of technology and privacy issues.

IoT has impacts on society in many ways. On the other hand, it is shaped by people's purchase behaviors and experiences. Preferences of customers regarding product design, their willingness to buy new technologies, security and privacy issues burst into prominence. There are a number of factors that determine people's purchase behaviors for IoT products such as; connectivity, interactivity, telepresence (their personal feelings about up to what level media represents physical and social environment), intelligence, convenience (savings from time and effort by consumers while planning to buy, purchase and use a product), security (Chang, Dong, & Sun, 2014); effectiveness, consistency, flexibility, privacy (Rau et al., 2015).

Customer experiences can be categorized as functional experiences and emotional experiences (Chang et al., 2014). Functional experience means objective cognition. On the other hand, emotional experience includes customer's individual feelings. Customer experiences have a mediating effect between IoT product specifications and purchasing behaviour (Chang et al., 2014). In other words, product specifications have a positive impact on customer purchase behaviour through functional or emotional experience.

Design is an important stage of IoT applications as it majorly determines customer purchase behaviour. In the process of designing interaction systems, effectiveness and consistency are always considered as important aspects. This is mainly due to users' tendency towards applications that solve their decision-making problems clearly and simply (Gao & Bai, 2014; Rau et al., 2015). There are also some other aspects for design of IoT applications, such as generation of data, acquisition, mining, transfer and interpretation.

Due to the fact that IoT services are based on technology, customer's acceptation of new technology is a crucial factor. Practicality and ease of use are the most dominant factors for customer acceptance of new technologies (Bao, Chong, Ooi, & Lin, 2014; Gao & Bai, 2014). Customers can adopt in case they think the newly proposed service is beneficial. Engagement is another determinant for customer acceptance (Gao & Bai, 2014). Social impact is also among the most important factors (Bao et al., 2014; Gao & Bai, 2014). It is due to individual's tendency to adopt a new technology that is widely adopted by others (Chong, Liu, Luo, & Keng-Boon, 2015). Every time, some people groups try and start using an emerging technology even at early stages of marketing, while some other people first wait and observe them. Based on the first users' experiences and proliferation of technology, other people also start using the technology and the technology becomes widely accepted.

Information privacy is important for enduring use of IoT. Gathering of information, unauthorized use, not allowed access and errors are the main sources of privacy concerns. Users will accept, and be motivated to use IoT services if they see them suitable for their values, norms and beliefs (Hsu & Lin, 2016). Intercompatibility among different devices and services is also important for persistent use of IoT (Bao et al., 2014).

3.4.2 Organizational Perspective

The IoT is expected to have a significant impact on individuals, businesses, and policy as societal and business models will be challenged, and new services will be introduced (Shin, 2014; Stankovic, 2014).

IoT is leading to radical changes in our world. Day by day, smart devices are entering our lives. Smart home, smart cities and smart grids concepts are expanding and growing each day. Industrial conventional processes are being outpaced by automation and IoT. IoT products and services are shining out in many areas such as health monitoring, traffic control, smart retail, logistic, smart agriculture and farming.

Interconnections between devices are increasing day by day. This increase is mainly expected to be sourced by the areas of home automation (Fernández-Caramés et al., 2017), transportation, defense and public security, wearable technologies and augmented reality.

Together with IoT new business areas will also emerge. Governmental applications and regulations will be revised and modified. Customer and employee profiles, expectations and needs will be reshaped. There will also be impact on environment, probably resulting in better protection of environment and higher environmental awareness. Landscaping, green energy, waste management systems will gain popularity. Green solutions, marketing and policies will be adopted. Expectations from new products and services will be quite different than of today. Sensors and smart devices will be widespread. Network, gateway protocols, system architecture and cloud solutions will be of vital importance for the firms. Consequently, software sector will be the sector of future more than it has already been foreseen today and there will be important breakthroughs.

IoT has already entering many areas of our lives and probably in the future it will be an essential feature like internet and phone, shaping our society. Like usual, companies that can rapidly adapt to changes, implement new technologies successfully in their product, service and processes and even shaping the emerging technologies will be stronger and maintain their existence. The companies that adapt to and implement emerging concepts faster than the others will be able to gain competitive advantage. All products, system and business processes should be shaped to foster this adaptation and implementation efforts. New business models, value chains, value-added services and ecosystems should be developed. Business organizations and processes should be modified considering recent changes. New economic models should be developed (Čolaković & Hadžialić, 2018).

Companies should be able to foresee opportunities about IoT. They should develop applications that will meet the expectations of both the market and the customers.

IoT provides numerous benefits for companies such as market transparency, operational effectiveness improvement and digital integration of value chains (Brody & Pureswaran, 2015). IoT has the potential and capacity to radically change market and business processes (Kim & Kim, 2016; Santoro, Vrontis, Thrassou, & Dezi, 2018). IoT allows creation of added value and this brings competitive advantage to companies. At the same time, it hooks up operation, resource and actors to each other, providing an important market and new opportunities (Andersson & Mattsson, 2015; James, 2012). Real-time data flow provided by IoT allows better understanding and meeting of customer needs.

3.4.2.1 Big Data

With the emergence of IoT processing of large amount of data became a main topic of conversation. The most important feedstock of Industry 4.0 age is data. Use of big scale data provides strategic supremacy to firms. It is quite important for the companies to understand the current state of markets in which competitions are densely taking place and dynamics are changing. This allows the companies to get one step further and provide accurate service to customers. Big Data, is a very important concept for large industries and supply chain. It allows companies to take decisions and actions faster than ever at strategic points, improving operation flexibility, responding changes in the market instantly, reducing costs and increasing profits (Görçün, 2016).

3.4.2.2 Cloud Computing

Cloud computing is a model that allows network access to configurable data processing resources (networks, servers, storage, applications), to a shared-common pool from everywhere. This model requires minimum management effort and service providers can instantly interact with the system to provide the required changes.

Cloud computing provides processing, use and storage of large scale and wide variety of data. Furthermore, it minimizes hardware and software investments for computing infrastructures. The need for storing, processing and analysing large scale data made cloud computing a preferable approach for many users (Bocek et al., 2017). Secure data storage, fast internet connection and standardization are among the main challenges that companies are struggling with today. Cloud computing seems to be a promising solution to these problems. Cloud computing offers man advantages for businesses. Cloud computing reduces costs, simplifies infrastructure complexity, enlarges work area and supports working from anywhere without specific setup in a cost-effective way.

3.4.2.3 Marketing 4.0

Markets and industries are reshaping and radically changing with IoT. In accordance with these changes, marketing operations and methods are also facing changes. Philip Kotler introduced a name for these new approaches in marketing: marketing 4.0. The main opinion defended by this approach is the necessity of coexistence of digital marketing and conventional marketing. The main purpose is to win customer and customer's brand evangelism (Kotler, Kartajaya, & Setiawan, 2016).

The following transitions are expected to take place from conventional to digital marketing:

- From segmentation and targeting to confirmation of customer communities
- From brand positioning and differentiation to brand character salience
- From 4P marketing mix (product, price, place and promotion) to 4C connected marketing mix (co-creation, currency, communal activation and conversation)

Marketing 4.0 has both traditional and digital marketing roles. Traditional marketing provides awareness and interest at the first periods that a customer and a company are interacting. As interaction proceeds, digital marketing becomes more important. Digital marketing provides drive action and advocacy.

Digital transformation changes customer needs, demands and expectations. Marketing 3.0 age was mainly customer oriented. Beyond traditional need and demands, customers were considered creative and voluntary participants of value creation. Marketing 3.0 age could also be defined as an era during which customer emotions were taken into consideration and marketing took place based on values. Beyond the specifications of products, sport, environment, sustainability and humanitarian social activities were popular.

Nowadays, internet allows people to share their product-service experiences in social platforms. Therefore, Marketing 4.0 approach focuses on product-service experience more than customers.

Marketing 4.0, allows customers to check the validity and reliability of a brand, confirm and increase its reputation and create value by participation through collaboration.

3.5 Conclusion

Nowadays smart technologies and devices are integrated at many parts of our lives, communicating and interacting with each other, leading to revolutionary developments. These trends, under the topic of IoT have the capacity and potential to change the world as we know it. New products, changing customer preferences and expectations, reshaping firm process and applications, forming agreements and alliances and even societal changes will be influenced by this technology. Many companies try to adapt their services, processes and application to this era of radical changes, through IoT. IBM, Daimler, ABB Group, Ericsson, Microsoft are among the pioneer companies in this field. Numerous new partnerships are established to benefit from different specialties in new projects. These changes and adaptation efforts are present at many different sectors such as health, finance, smart buildings and cities, smart manufacturing, farming, telecommunication, transportation, etc. Demand and expectations will change together with the changes taking place in several areas. New fields of profession and business fields may emerge. Software and information sciences are expected to gain more importance. The terms such as big data and cloud computing have already become important, shaping numerous new products and services. Skills and perfections that are expected from both the existing and future prospective employees are facing changes in this direction. Marketing perspectives are also transforming into digital marketing.

Although IoT brings together many advantages, it has some challenges and points that require particular attention. Especially privacy and security are the forthcoming main challenges. Blockchain is becoming a major solution option for overcoming these challenges. It provides a standardized reliable mechanism with a transparent database structure.

IoT has massive potential and it is being developed even more day by day. Companies need to turn it into an advantage. This critical change requires new business models and applications. Companies that will not be able to provide these will face the danger of extinction.

Future works can investigate the social side of IoT and its impacts on the society. The role of IoT in the management of modern foundations can be explored. Firms that prefer blockchain in IoT applications can be compared with firms that have IoT applications without blockchain. Alternative applications, structures and approaches for security and privacy in IoT can be investigated and compared with blockchain.

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Chapter 4
A Blockchain Based Framework for Blood Distribution

Mehmet Çağlıyangil, Sabri Erdem, and Güzin Özdağoğlu

Abstract Today's businesses have been evolving along with the technological developments, such as Industry 4.0, internet of things, and blockchain technology, in order to create not only fully digital and traceable but also transparent, reliable and secured environments. Blockchain technology serves for developing the transparency, reliability, and security characteristics of these environments even if it is frequently mentioned along with the monetary systems such as Bitcoin. The most common purposes to adopt the blockchain technology is to redesign and integrate processes, supply chains or financial arrangements. This chapter proposes such an Ethereum blockchain based framework called KanCoin concerning this potential in order to manage and adjust the processes for efficient distribution planning in blood delivery system from donors to distribution centers and patients at medical centers in a more effective way than the conventional procedures.

4.1 Introduction

Businesses have announced that they have started to use or are considering using blockchain-based applications to redesign and integrate their processes, supply chains or their economic arrangements. Due to the fact that blockchain systems are ordered, incremental, sound and digital (Conte de Leon, Stalick, Jillepalli, Haney, & Sheldon, 2017), they are ideal for Industry 4.0 environments. With the use of Industry 4.0 and the Internet of Things, there will be a lot more microcomputers with different sensors and capabilities. Hence, managing the tremendous data from these devices will be a very burdensome job with traditional databases. However, blockchain applications can be used in these kinds of environments because it enables the use of newer technologies. In the recent studies concerning blockchain structures developed for supply chains or distribution networks, the focus has

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naturally been on how these structures can be used to redesign the network among suppliers and other parties in the supply chain along with the help of the technologies provided by Industry 4.0 and Internet of Things.

Bitcoin can also be seen as a supply chain management tool for money. Through Bitcoin software (or related crypto software) miners uncover Bitcoins (or other related cryptocurrencies) and uncovered Bitcoins are held in a structure called a blockchain. All users are on the blockchain, all transactions are processed through the blockchain, and all transactions and user data are stored in the blockchain. We can say that blockchain is both a Distributed Ledger Technology and it can also be thought of as a Supply Chain Management (SCM) tool because it handles both storage and distribution of money. From this perspective, the distributions through the suppliers in a chain can be reconsidered based on the logic behind the blockchain structure of the current cryptocurrencies, especially Bitcoin. This chapter proposes a framework concerning this potential in order to manage and adjust the processes for efficient distribution system over a particular scenario.

The paper is organized as follows: the second section describes the historical and technical background of Bitcoin; the third section summarizes particular areas where blockchain technology is utilized; the fourth section presents a framework for a distribution system that was developed based on a blockchain. The fifth section concludes the paper.

4.2 Historical Background of Bitcoin

Bitcoin is the most successful and widely accepted attempt at an anonymous transaction system; however, it is neither the first nor the last. Logistics, communication, and cryptography have grown together throughout history. Caesar Ciphers were invented 2000 years ago because the Roman Empire grew bigger and built roads in order to control its borders and colonies, but messengers were commonly killed or kidnapped resulting in important messages ending up in the hands of enemies of the state. In order to secure the messages, different kinds of ciphers were implemented, which were primitive compared to modern ones (Churchhouse & Churchhouse, 2002). In the early twentieth century, similar reasons caused the invention and decryption of the Enigma machine. It was only after Claude Shannon's seminal paper "A mathematical theory of cryptography" in 1945, that cryptography was considered as a new branch of science (Shannon, 1945).

Bitcoin is defined as a "system for electronic transactions without relying on trust" by its creator, Satoshi Nakamoto, in the pioneering white paper (Nakamoto, 2008). Just 2 months after the white paper was published, Bitcoin was implemented in an actual working system. The first (or zeroth index number) block, the famous genesis block, was created on January 3rd, 2009 at 8:15:05 PM UTC. With the Genesis Block, the first 50 coins were created, or "mined" in Bitcoin terminology, with a message as the coinbase parameter: "The Times 03/Jan/2009 'Chancellor on brink of the second bailout for banks'". The term, Coinbase, refers to the first transaction in a block. It creates new coins from nothing. It is always created by its miner. In this case, it was actually a side note to history by Satoshi Nakamoto himself (Bitcoin, 2019; Coinbase, 2018). This coinbase entry is a direct reference to a Times article and it is important in two respects: first, it proves that the first block was created on or later than third of January 2009. Second, it highlights Nakamoto's distrust of the fractional-reserve banking system which he repeatedly reminded to the bitcoin community with his forum posts from 2009 until his disappearance in April 2011 (Davis, 2011).

In 1998, Wei Dai proposed "B-Money", a crypto-based currency which also uses Hashcash (Dai, 1998). Dai (1998) has pioneered ideas similar to blockchain (verifying via a collective ledger book) like rewarding miner's efforts and signing transactions with digital signatures. Around the same time, Nick Szabo proposed "bit gold" which is a distributed money system that can prevent the double spending problem (Szabo, 2008). The concept was so similar to Bitcoin that many speculated that Satoshi Nakamoto and Nick Szabo were the same person. However, unlike Bitcoin, "bit gold" was never actually implemented. There were also many other projects related to cryptography, finance, computer science, and monetary systems that paved the road for the Bitcoin (Narayanan et al., 2016).

4.2.1 Technical Background

It is safe to say that the most important motivation behind Bitcoin was "distrust". The aforementioned white paper was not published in a scientific journal or in a respectful magazine. It was first published on a cryptography mailing list at (archive, 2008; metzdowd, 2019; wikizero, 2019).

The 1970s witnessed the birth of the modern cryptography with the development of the Data Encryption Standard, the concept of a Public Key and early attempts at hashing (Konheim, 2010). The first attempt at a cryptography backed currency was David Chaum's DigiCash in 1989. DigiCash eventually went bankrupt, but Chaum's works in Blind Signatures (Chaum, 1983) and anonymous communication (Chaum, 1981) have been the key concepts for Cypherpunks (Cypherpunk, 2019).

Bitcoin is a decentralized trustless system for electronic payments which also maintains its users' privacy (Nakamoto, 2008). Antonopoulos (2014) defines it as a "collection of concepts and technologies that form the basis of a digital ecosystem". It has four major parts, these are the Bitcoin Protocol, Proof-of-Work, Consensus Rules, and Blockchain. The Bitcoin Protocol is the network aspect of Bitcoin. It is a decentralized peer-to-peer network.

Proof-of-Work is an algorithm that verifies the integrity and authenticity of transactions.

Bitcoin and some of its predecessors used Hashcash (Back, 1997a) as a Proof-of-Work (PoW) algorithm. Proof-of-Work can be considered the key to an extremely hard but solvable puzzle; easy to verify but unlikely to guess. Blockchain uses Hashcash for PoW, basically known as mining.

Consensus Rules make Bitcoin a trustless system which does not require a "trusted" third party. Transactions, nodes, and blocks are verified through Consensus Rules. The blockchain is the most hyped aspect of the Bitcoin. It is basically a distributed ledger technology (DLT) which does not require a trusted third party. All data related to Bitcoin, is kept on the Bitcoin Blockchain. All the data is available to the public and it is also used for verification and security purposes.

Of course, blockchain technology not only covers the Bitcoin system, it also has provided new insights and inspirations for redesigning and rethinking other existing systems.

4.2.2 Proof-of-Work

Proof-of-Work has been used as a synonym for Bitcoin mining for a while, however, they are not exactly the same thing. Proof-of-Work, which is used as the consensus mechanism in the Bitcoin Blockchain, was originally proposed to solve the junk e-mail problem. The idea was that by requiring some computational work from the sender, abusing the system would be more costly (Dwork & Naor, 1992). One of the pioneers of cryptocurrencies, Hal Finney, developed a way to use reusable proofs of work as an electronic payment method (Finney, 1997). Bitcoin used Finney's method for Bitcoin creation, which was also based on Adam Back's Hashcash (Back, 1997b). Proof-of-Work requires computational power, but as Bitcoin's value increased rapidly, its demand for power has increased too. This has resulted in computational "puzzles" for miners that have become much harder to solve. The Bitcoin Blockchain's rules require that creating a block takes 10 min (600 s). In order to achieve this 10-min goal, Bitcoin adjusts the difficulty of block creating after every 2016 blocks generated (about 2 weeks). Basic mathematics suggests that when the time is constant, and computing power increases, Bitcoin's computational puzzle's difficulty level must be increased in order to maintain the Bitcoin creation rate. For the first few thousands of blocks, Bitcoin could be mined using CPUs. Later CPUs were abandoned in favor of GPUs, and GPUs were eventually replaced by Application-Specific Integrated Circuits (ASIC) which were custom made for Bitcoin mining purposes. In 2019, it is more than six trillion times harder to solve the computational puzzle, compared to 2010. With the increased difficulty, electricity consumption for Bitcoin mining has skyrocketed, and has even surpassed several nations electrical consumption. The Bitcoin network consumes more energy than most countries, which makes it an environmental threat (Krause & Tolaymat, 2018). This threat has caused new innovations, such as Proof of Stake (POS) (Saleh, 2018) and its variants, Proof of Space (PoSpace), Proof of Space-Time (PoST), Proof of Activity, Proof of Importance, and Proof of Burn to achieve distributed consensus (He, Guan, Lv, & Yi, 2018). There are also solutions like IOTA's Tangle, directed acyclic graph (DAG) technology variants and various other technologies which use different data structures than blockchain (Cachin & Vukolić, 2017; Yeow, Gani, Ahmad, Rodrigues, & Ko, 2018).

4.3 Blockchain Technology

In 2014, one of the most important figures in the Silicon Valley, pioneer of the internet revolution, Marc Andreessen claimed that Blockchain is the most important innovation since the Internet (Crosby, Pattanayak, Verma, & Kalyanaraman, 2016). Blockchain is the backbone of the Bitcoin-like cryptocurrencies, and all other major parts of the cryptocurrency ecosystem are directly in touch with Blockchain. However, the roots of Blockchain date back to the early 1990s, when Haber and Stornetta (1990) proposed ways to digitally timestamp data, hashing it and then linking it back to back in chronological order. Wei Dai had the idea to use this method in cryptocurrencies. Nakamoto invented the Blockchain and published it in his now famous white paper (Nakamoto, 2008). Nakamoto did not use the term "Blockchain" or "block chain" in the paper, however, he used the terms "block" and "chain" 67 and 27 times respectively. The Cryptocurrency community coined the term "Blockchain" in time.

The invention of Bitcoin has proved that with its blockchain technology, decentralized networks with proper consensus algorithms can be trusted without a need for trusted third parties. For the first few years, blockchain was only used in cryptocurrencies because the cost of setting up and operating nodes for blockchain databases were high and people only undertook this risk with the motivation of getting paid in cryptocurrencies. As the technology matured and went mainstream, enhancements, alterations, and customizations to blockchains have been made.

Over the last decade years, we have seen that Blockchain can be used outside of Bitcoin. Actually, blockchain is seen as the merger of the "database" and "network" in computer systems, and it makes blockchain technology ideal for identification, registration, distribution, transfer, and tracking of any digital asset. Blockchain, as a database system, puts transactions together in blocks, encrypts them and links these blocks to each other by starting each block with the previous blocks' hash (Nofer, Gomber, Hinz, & Schiereck, 2017). With the verification of each block, transactions in the chosen block propagated through the network to all other nodes which keep track of the chain of blocks.

Bitcoin and other alternative money systems based on Blockchain are called cryptocurrencies because of the heavy usage of hashes. Hashes are generated via hash functions and are widely used in cryptography, computer science, storage management, and for other purposes (Konheim, 2010). Hash functions basically take input data of any length and transform it into an output with a fixed length. Hash functions have some common properties (Blockgeeks, 2017). Most importantly hash functions are "deterministic" which means that every time the function runs; the same input generates the same output. "Quick Computation" is important for the efficiency of the system. "Pre-Image Resistance," which makes it infeasible to find the input from the output, is vital for security purposes. Additionally, small changes in the input should change the whole hash, there should be no structured resemblance between two similar inputs. A hash function must be "collision resistant" which makes it infeasible to have the same output from different inputs. "Puzzle

Friendliness" is another concept, which makes hash functions ideal for Proof-of-Work (mining).

4.3.1 Permissioned Versus Permissionless Blockchains

Some proof-of-work methods operate only on permissioned blockchains, some work only on permissionless blockchains and some work on both. Permissionless blockchains do not require any identification. Its participants are generally anonymous or pseudonymous, like Bitcoin or Ethereum. On the other hand, permissioned blockchains require some kind of Know Your Customer (KYC) or Know Your Business (KYB) procedures to allow a business or person to participate in their blockchain. Even though there are some attempts such as ChainAnchor for anonymous identities in the permissioned blockchains, anonymity is not one of the most important features in this kind of blockchain (Hardjono, Smith, & Pentland, 2014; Swanson, 2015). This little difference has a major effect on some properties of their respective blockchain systems. Permissionless systems have some advantages such as protection against identity forging attacks and lower control costs. However, it is very important for these kinds of blockchains that rules and incentives are perfectly clear and operational before the implementation, otherwise people and businesses will not use it or abuse the blockchain (Peters & Panayi, 2016). The most obvious advantages of the permissioned blockchains are their efficiency and scalability compared to the permissionless blockchains. Permissionless blockchains generally require each of their nodes to fully keep the database and propagate new blocks to each of their nodes within seconds, thus permissionless databases are generally more costly. For these reasons, Bitcoin and Ethereum Blockchain sizes are now hundreds of gigabytes and Bitcoin has a limit of seven transactions per second, while Ethereum can handle a maximum of 25 transactions per second. These hundreds of gigabytes sized blockchains are also being kept on thousands of nodes which in total accounts for petabytes of blockchain data, and it is stored only just for simple transaction data. Conversely, transparency and centralization are major issues with permissionless blockchains. Basically, with permissioned blockchains groups of people or businesses can exchange goods, services, funds, and information securely with each other while not completely trusting other sides (Androulaki et al., 2018).

Other than permissioned vs permissionless, there is another separation for blockchain types: Public, Consortium, and Private blockchains. Public blockchains are permissionless ones, everything is transparent to everyone and anybody can participate. However, Consortium and Private blockchains are permissioned. Consortium blockchains, sometimes referred to as Federated Blockchains, are used by a group of different people and companies with predetermined rules, roles, and authority (Voshmgir & Kalinov, 2017). Typically, platforms such as R3 Corda and Hyperledger Fabric provide the infrastructure. Private blockchains are generally used within an organization for traceability and accountability, the database can be read from public or outside of the organization, but all "write permissions" such as

Table 4.1 Properties of different kind of blockchains

Property	Public blockchain	Consortium blockchain	Private blockchain
Consensus determination	All miners	Selected set of nodes	One organization
Read permission	Public	Could be public or restricted	Could be public or restricted
Immutability	Nearly impossible to tamper	Could be tampered	Could be tampered
Efficiency	Low	High	High
Centralized	No	Partial	Yes
Consensus process	Permissionless	Permissioned	Permissioned

Source: Zheng, Xie, Dai, Chen, & Wang (2017)

transactions, verifications, and identifications are kept inside the organization (Buterin, 2015). In this context, Table 4.1 shows the main differences between different types of blockchains.

Even though there are differences among blockchains, most blockchains share some common characteristics and properties (Conte de Leon et al., 2017). They are "ordered", the data kept in the blockchains are ordered according to their rules. Their blocks are "incremental", the chains start from 0 or 1 and are linked back to back with each other via timestamps in a linear way. They are "sound" which means that each transaction can be verified using blocks. And of course, they all are "digital". Other than these characteristics, most of blockchains are virtually immutable, which means, in order to change a past transaction, most of the blockchain data should be changed as well, which is possible but infeasible. Also, other than some private permissioned blockchains, blockchains are distributed.

Bitcoin Blockchain and its variants are also sometimes referred to as Blockchain 1.0, while Blockchains with "Smart Contracts" are referred to as Blockchain 2.0. Nakamoto himself hinted in a post that Bitcoin has more capabilities than just directing payment and bitcoin addresses have built-in support for escrow transactions, third-party arbitration, multi-party signatures and more (Nakamoto, 2010; Swan, 2015). He suggested exploring these technologies after Bitcoin becomes popular.

4.3.2 Ethereum and Smart Contracts

In 2014 Vitalik Buterin, a teenage prodigy, criticized the Bitcoin Blockchain for not being Turing-complete and other issues. He then proposed "A Next Generation Smart Contract & Decentralized Application Platform" called Ethereum (Buterin, 2013). Ethereum has its own cryptocurrency called Ether but it is not limited to that. The Ethereum Virtual Machine is a Turing-complete Blockchain, which in simpler terms is a fully programmable blockchain. Turing-completeness says that anything can be computed with a Turing-complete program, can also be computed with another Turing-complete program (Kepser, 2004). So, Ethereum does not limit its users' capabilities with its programming language as Bitcoin does. Ethereum is considered the first Blockchain 2.0 application, because of its capabilities and similarity to the visions of Nakamoto and other Bitcoin enthusiasts. Smart contracts in Ethereum are generally small programs that bind the transaction to a statement, such as "if team *A* wins, send *X* Ether to *ABC* address". These smart contracts and other programs can be written in several programming languages, according to the developer's choice, but most popular Ethereum language is Solidity which is similar to C and JavaScript programming languages. There are other Ethereum programming languages like Serpent, Vyper, LLL, Mutan and JULIA...

The emergence of Ethereum with its new capabilities, has started a new era for blockchains. Businesses realized that with the new programmable blockchains, they could migrate some of their business processes to blockchains, and by doing so they could decrease their costs and improve security and traceability while making their organization more transparent to the public. Most importantly, they realized that they can seamlessly integrate their forward and backward logistics channels and resolve most chronic problems such as inventory costs, system incompatibilities, communication problems, human errors, system errors and fraud, all without trusting a third party.

One of the most important problems in the big data era is to find out the source, or in broader terms, determining provenance (Kim & Laskowski, 2018). Since there are vast amounts of data which flows constantly and rapidly, it is difficult to trace or keep track of each data point by traditional methods. The same situation applies to actual goods, services and, information. With traditional supply chain management technologies, organizations tend to use barcode or RFID like technologies through their supply chain, but once the product is out of their chain, they may be unable to trace or transfer historical data related to the product to their customers or partners. Furthermore, in most cases, they do not have any data before packaging. In 2018, the romaine lettuce crisis happened, when somehow romaine lettuces were contaminated with the deadly *Escherichia coli* bacteria. More than 200 people in 36 states of the U.S. were infected and at least five people died (Fox, 2018). Authorities failed to find out the origin of the outbreak in time, so all romaine lettuce in the U.S. had to be thrown away out. After the incident, companies like Walmart decided to enforce the use of blockchain to all its suppliers in order to be able to trace their product from soil to the dinner table (Smith, 2018). By using blockchain, the root of the problem can be traced back within seconds, instead of days or weeks, and customers can trust their foods' safety. Also, blockchain gives markets much-desired agility and the ability to act immediately in that kind of crises.

4.3.3 Application Examples of Blockchain

Different blockchains have been created for different purposes such as financial services, games, intellectual property (IP) protection, insurance, healthcare, voting, identity verification, registration, provenance, and supply chain management. With the implementation of smart contracts, blockchains have become even more compatible with industry 4.0 standards. The entrance of logistics and information technology giants such as DHL and IBM have attracted attention to supply chains empowered by blockchains. Although blockchain is just a 10-year old technology, it has affected many businesses and industries. It clearly has the potential to change the world radically.

Apart from physical goods, researchers have shown that digital supply chains, which exchange information related to finance, production, design, research, and competition can benefit from the implementation of blockchains. Blockchain applications with functionalities like timestamping, constant monitoring and tracking all act as facilitators in a supply chain. Money is just like other goods, constantly changing hands throughout the world, however, due to strict regulations and outdated technology standards, transferring money, even digital money, is much harder than most of the other goods. As Sorkin reported in his book, in the midst of the infamous 2008 crisis, Japan's biggest bank, Bank of Tokyo-Mitsubishi UFJ, had acquired a part of Morgan Stanley, one of the biggest banks in the USA (Sorkin, 2010). The interesting part is, Morgan Stanley was out of cash at that time and in order to sustain its business, it needed that money from the deal immediately. Unfortunately, when the deal was made on Monday, October 13th, 2018, both American and Japan banks were closed due to a banking holiday in both countries. So, the world's largest check, valued at nine billion dollars (Time, 2012), was written and signed on a piece of paper with a pen, then executives from Japan's biggest bank, physically went to Morgan Stanley and hand-delivered the check. This happened in the age of the internet and instant communication. This example showed that changes were needed in the monetary system, which had not thought of any advancing changes for hundreds of years.

The blockchain structure has offered a good alternative to SWIFT for money transfers. Bitcoin can be sent within minutes, though, for safety reasons, bigger transfers are generally confirmed with 3–6 blocks confirmations (30–60 min on average). The blockchain mechanism is also extremely reliable. The Bitcoin network has been functional for 99.98% of the time since the creation of its genesis block (Bitcoin Uptime, 2019).

The transaction fee of Bitcoin is affected by its market price, traffic congestion, and other factors, however, it has been less than $1 since February 2018, and as of March 2019, it is around 20 cents per transaction (Bitcoin Transaction Fees, 2019). For these reasons, some logistics companies have experimented with replacing fiat currencies with Bitcoin (Almeida, 2018). Bitcoin has many superior features; however, Bitcoin is not ideal for some supply chains because some supply chains and businesses aim for split second transfers instead of minutes. They aim for no-fees instead of paying cents or dollars. Visa can handle tens of thousands of transactions per second, while Bitcoin can only handle seven. So, different blockchain-based alternatives appeared in order to solve this kind of problem. One of the earliest implementations was Ripple, which is rooted back to 2004, but has transformed itself and gained popularity with its cryptocurrency XRP in recent years. It focuses on fast and cheap money transfers.

More than 50 banks, such as Akbank, Bank of Tokyo-Mitsubishi UFJ, Santander and BBVA are members of RippleNet and they use Ripple to transfer money internationally via the Ripple network (Patterson, 2017). While Ripple aims at banks, its closest competitor Stellar aims to reach two billion adults with no bank accounts, by facilitating its community and its "lumen currency" (XLM) with minimal transaction fees, currently less than a thousandth of a cent (Stellar, 2019). On the other hand, Ripple's traditional competitor SWIFT announced that they partnered with blockchain consortium R3 Corda for its global payment innovation for fast and frictionless international payment operations (Copeland, 2019; Swift). As mentioned earlier Corda is an open source permissioned blockchain platform for businesses, concentrated on finance. Instead of using a public blockchain like Bitcoin or Ethereum, Corda gives options to its clients to decide on who gets access to their transaction data. Corda is also capable of smart contracts which allow automatic transactions for its clients.

Just like Corda, Hyperledger is also an open source permissioned blockchain project platform. The Hyperledger community, led by the Linux Foundation and IBM, created a blockchain ecosystem, which they called Hyperledger Greenhouse, consisting of different but related frameworks and tools (Hyperledger, 2019). In the greenhouse, different projects interact and "pollinate" each other, thus enhancing each other while creating new projects. The Hyperledger Fabric framework is the focal point of the Hyperledger ecosystem, and it takes container technology further to introduce smart contracts called "chain code" that can be covered throughout the system (Hyperledger, 2019). Apart from the infamous romaine lettuce incident, there were 17 more reported food borne illness outbreaks in the USA in 2018. In order to react to a possible outbreak, Walmart measured how much time they needed to trace the provenance of their mangoes and found out that it would take about 7 days. After that, they partnered up with Hyperledger Fabric and reduced this time to just 2.2 s. Due to the massive success of the implementation, Walmart now traces 25 different products with Hyperledger Fabric blockchain.

Provenance is important not only during crises, it is also important for sustainability and ethics. One of the earliest blockchain startups gets its name for what it does, Provenance helps companies to increase their supply chain transparency (Provenance, 2019). Opaque supply chains can hide ethical problems such as the use of slavery, war crimes or child labor, and also quality issues such as authenticity of certification frauds. Provenance uses smart NFC tags, and QR code labels to link products to their data at every step of its supply chain. Provenance has created a platform for producers to put their proofs on an immutable blockchain, so that end-customers can track what they really have bought by scanning QR codes or tapping on NFC tags.

With this blockchain-based technology, consumers can check their food's origin, freshness, and the authenticity of its certifications such as whether it is organic, allergen-free, halal, kosher etc. Consumers can check if the people who have stitched their new jackets and the person who has sold that jacket in the store have gained fair payment for their work. They can even see from which animal their jacket's yarn is made from. Furthermore, it rewards quality and ethical producers, they can tell their stories by creating digital history, show their resources to their customers with proofs, differentiate from other brands more easily and gain customer trust. It also enhances collaboration and integration within a supply chain by creating a unique digital passport for each product, through which any defect would be detected easily.

Provenance is one of the first startups to concentrate on supply chain transparency using blockchain, however it is not the only one. There are more similar startups such as EverLedger, edgeVerve's NIA Provenance, AgriLedger, Trust Provenance, Circularise, bext360, TE-Food and Blockverify (Everledger; Edgeverve; Agriledger; Trust Provenance; Circularise; bext360; TE-Food; Blockverify).

Tracking the current location of a product is very different from tracking where the product has been. Global shipping leader Maersk, partnered with IT giant and blockchain pioneer IBM in order to create TradeLens, a global blockchain platform to improve visibility across supply chains and eliminate inefficiencies caused by legacy systems (Scott, 2018). TradeLens is based on the Application Programming Interface (API) integration on a centralized blockchain and they are currently testing their solutions.

There are lots of blockchain-based solutions for maritime logistics. ShipChain unifies tracking and tracing with its Ethereum-based smart contracts and side-chained blockchain (Briggs, 2018). Global Shared Container Platform (GSCP) is a freight container registry blockchain platform which aims to allow the industry to keep real-time track of all containers and manage container handling transactions (blockshipping, 2019). T-mining is a framework which enables building blockchain based decentralized networks with reusable smart contracts on demand for maritime logistics. Wave, CargoX and Zim have blockchain based solutions to eliminate bill of lading with smart contracts, and TallySticks tries to eliminate all related proforma invoices, purchase orders and related attachments (Wave; CargoX; Zim; Tallysticks). Blockfreight, BitNautic and many other projects also compete to become the leaders of blockchain in the shipping industry (Blockfreight; BitNautic).

The energy industry also has various solutions for its supply chain using blockchain. LO3 Energy enables peer-to-peer transaction of electricity with its innovative grid and blockchain system (The Future of Energy, 2019). Irene is an energy management platform built on Stellar blockchain (Irene). SolarCoin is a cryptocurrency, based on solar energy production (SolarCoin). Electron, Power Ledger, Energy Web, Enerchain, Elon City, We Power and many more blockchain startups are trying to make changes in the energy sector (see Electron; Power Ledger; Enerchain; Elon City; We Power).

There are also some blockchain projects that promise to handle all supply chain processes, such as OriginTrail, EximChain, skuchain, Hijro, Waltonchain, VeChainThor, Zerv, BiTA, Olistics, kouvola.innovation, CargoLedger, Modum

(OriginTrail; EximChain; Skuchain; Hijro; Waltonchain; Kuovala.Innovation; CargoLedger; Modum).

There are considerable number of blockchain based projects, in every industry, throughout all over the supply chain. Some focus on a niche problem, some take a holistic approach and manage the supply chain end-to-end. Some projects have failed already, while most of them are burning cash and are about to fail. However, new projects that integrate supply chain and blockchain appear regularly. There is still room for new projects, but the space is being invaded by industry giants and only the projects that solve crucial problems, optimize the blockchain trilemma by optimizing scalability, decentralization, and security with good incentives seem to thrive.

4.4 A Proposed Framework for a Supply Blockchain: KanChain

Business supply chains are not the only ones making use of the blockchain technology. Healthcare supply chains are not as common as others, but they may be considered more “vital”. Considering the intimacy of healthcare data, blockchain solutions are more suitable for healthcare supply chains. However, there are not yet that many blockchain solutions for healthcare. Hölbl, Kompara, Kamišalić, and Nemec Zlatolas (2018) has reported that although blockchain technology research in healthcare is increasing, it is mostly used for data sharing and recording data, while using it for supply chain management is rare.

Some companies like Imperial Logistics and FarmaTrust use blockchain to manage pharmaceutical supply chains (business review webinars, 2019; FarmaTrust, 2019). There are some other experimental projects such as OrganTree and Dhonor Blockchain to connect organ donors, recipients and practitioners by using incentives such as paying for funeral costs (Organ Tree, 2019; Dhonor, 2019).

There are also some proposals for blood donation tracking. BloodChain and SmartBag focus on preventing contamination in the supply chain and on reducing the spread of HIV in developing countries (BloodChain, 2019; Giwa, 2018). Another project, also called BLOODCHAIN, focuses on motivating blood donors by giving monetary returns. Even though some projects seem futuristic or are in an ethically gray area, most of them are technically feasible. However, building a blockchain just because it is feasible is generally a waste of time and valuable resources. Wüst and Gervais (2018) have proposed a flow chart to determine whether to use blockchain or not. So, according to the flowchart (Fig. 4.1) is there a need for blockchain in blood donation tracking?

A blood donation can occur in blood donation centers, hospitals, mobile donation centers and in any kind of certified healthcare institution and it has to be immediately analyzed and recorded on a database. In most countries, trusted third parties (TTP) are governmental databases which have lower than industry uptime. As mentioned

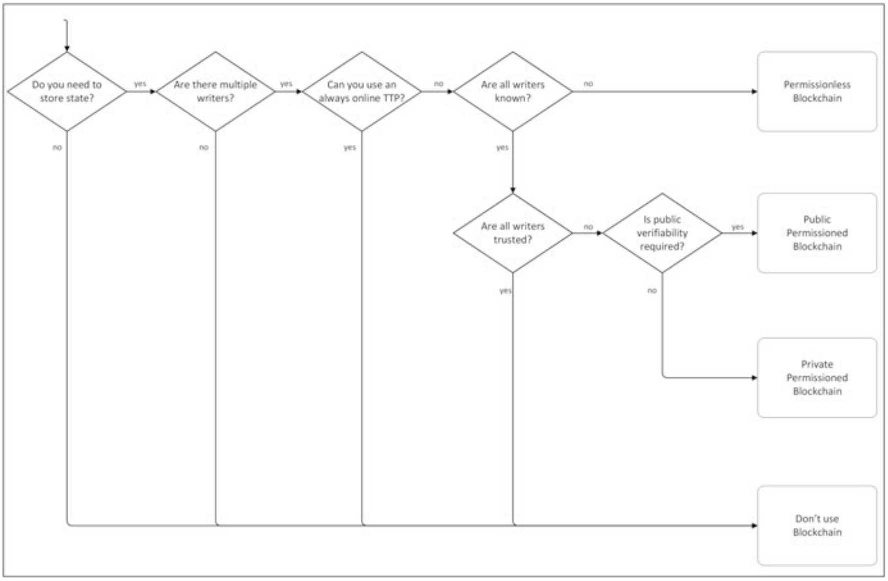

Fig. 4.1 Framework for blockchain decision. Source: Wüst & Gervais (2018)

earlier, data writers must have some kind of certification, so they are all known. However, blood data is very intimate, so users cannot trust all writers with using their blood data well and responsibly; they might suspect them of abusing their blood data. Public verifiability is not required and not possible for this kind of data. So, the flowchart recommends using Private Permissioned Blockchain for blood donation supply chain.

At this point, this study proposes an alternative Ethereum-like blockchain, we call KanChain, for the blood donation supply chain (Fig. 4.2).

The chain would work with respect to the following rules and principles:

- In this blockchain, "write permissions" are given only to certified blood donation centers (CBDC) throughout the system.
- Every donor is introduced to the Blockchain via KYC-like registration in CBDCs, with their country code + their social security/identity number, and a password.
- Once they are introduced into the system, a donor's identity is anonymized via hash functions. The donor will have public keys, and their password-protected account will act like cryptocurrency wallet.
- Transactions can only be associated with donors by the control body of the blockchain, which can also give access to users if they forget their password.
- Once blood is taken from donors, all the data about the blood will be put on the KanChain, donors can track their blood analyses in real-time by logging on to their account and will be notified when their donation is used.
- Each donor receives a KanCoin (token) from their CBDC after their donation is accepted.

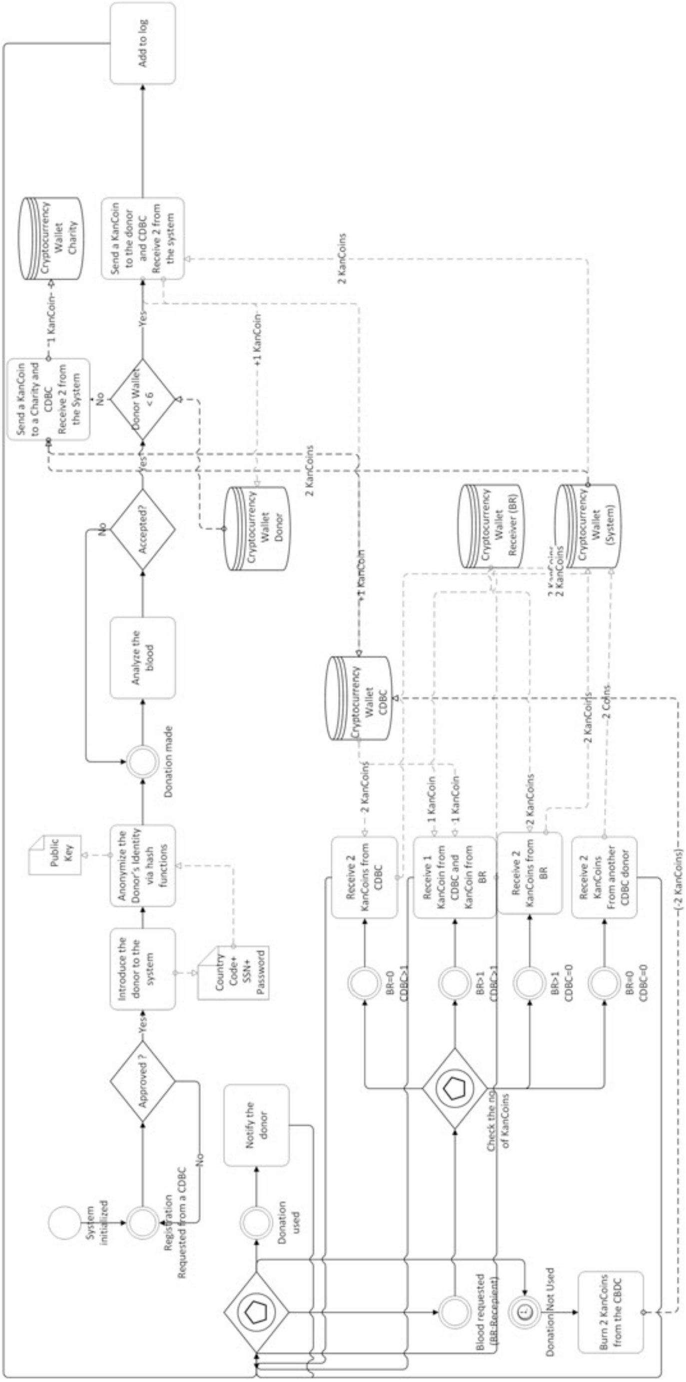

Fig. 4.2 Workflow of the proposed framework for KanChain

- Once a hospital needs a certain type of blood, it can search for it through the blockchain, the optimized results according to availability (distance, country, scarcity et cetera) will be shown to the requester. An automatic message will be sent to the top available CBDCs with a smart contract attached with KanCoin and the first CBDC to approve the transfer gets coins and sends the blood.
- Initial KanCoins will be distributed to CBDCs according to their blood supply. Persons can either be a donor or blood recipient, according to the transaction type. For each donation, both CBDC and donor will get 1 KanCoin (CBDC +1, Donor +1, System −2).
- For blood transfusion, if a blood receiver (BR) has 0 KanCoin and CBDC has more than 1 coin, CDBC will give 2 KanCoins to the system (CDBC −2, System +2).
- If both have more than 1 KanCoin, both BR and CBDC pay 1 KanCoins to the system (CDBC −1, BR −1, System +2).
- If BR has more than 1 KanCoin, CBDC has 0, BR pays 2 KanCoins to the system (BR −2, System +2).
- If both BR and CBDC have fewer than 1 KanCoin, then they can transfer KanCoin from a person or CBDC (another CBDC or Donor −2, System +2).
- Transfers can be realized through the blockchain, and donors can transfer their KanCoins to CBDCs and special entities called Charity.
- Person-to-person transactions are prohibited, because of possible ethical problems.
- In order to prevent hoarding, donors can have a maximum of 6 KanCoins, they have to donate excessive KanCoins to Charities. Charities can donate KanCoins to persons and CBDCs in need.
- The system starts with 0 coins and credits 2 coins for each donation, while debits 2 coins for each transfusion.
- Just by looking at the changes in the System’s KanCoin numbers change in blood supply can easily be traced.
- Only the System has permission to hold a negative number of KanCoins.
- The initial KanCoin in the system is equal to two times that of the available blood supply units (2 KanCoins for a unit of blood is distributed) and initial System coin is 0.
- If system has a positive number of coins, it means there are more transfusions than donations since the system initialization. If system coins are negative, it means there are more donations, than transfusions. In order to account for inventory losses (blood cannot be used), the system controls unused blood every month and burns 2 KanCoins from the related CBDC’s account (CBDC −2, System 0).

4.5 Discussion and Conclusion

In this study, we have reviewed the basics of Bitcoin-like cryptocurrency systems, especially the blockchain mechanism, its variants and different application areas. We have also proposed a new blood-supply management system based on an Ethereum-like blockchain which would be more effective (i.e., minimizing the waste and maximizing the delivery cost and time) at delivering quality of service and products could be performed from donors to blood accumulation and distribution centers and patients at hospitals and health centers.

With this blockchain, cross-border searches for suitable blood for certain types of blood transfusions (e.g. stem cell) can be done easily. Donors would get more motivated, because they would be sure that they are donating to people in need and they have the ability to use their blood in future for themselves or for people they care about, moreover they have the option to choose from Charities to donate their blood. Blood Recipients do not have to care about anything unless there is no blood supply in their CBDC; however, normally when there is a scarcity of blood, BR generally must find their own blood or barter blood. Through the implementation of the KanChain, they can get it on the blockchain. CBDCs would manage their supply chain better by means of tracking their KanCoins. Any problem related to blood can be traced back immediately, while privacy of donor is protected. A blockchain based supply chain solution for blood donation could be beneficial to all of its stakeholders.

The model proposed here can be generalized to other similar areas like organ-donorship and could work both intranationally or internationally by integrating country-wide systems based on the aforementioned mechanism. Additionally, policy makers could regulate the systems by adopting appropriate regulations and encouraging donations.

Further studies can be done based on simulating the proposed systems with real application scenarios and more specifically, developers could customize the Ethereum blockchain mechanism for the blood donorship area.

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Chapter 5
Developing a Supportive Culture in Digital Transformation

Güney Çetin Gürkan and Gülsel Çiftci

Abstract Nowadays, technology has become an indispensable part of our lives. Technology plays a major role in our daily lives, even in important areas such as health, banking and education. Being aware of this, organizations adapt these technological developments to themselves in order to satisfy customer needs in a timely and complete manner and not to fall behind in a fiercely competitive environment. In particular, organizations that want to develop web-based electronic sales networks and to be one step ahead of their competitors focus on digital transformation. Organizations have to carry out organizational change in accordance with these processes in order to sustain their commercial assets. Organizations create a digital culture by adapting their culture to the new format in order to be successful during this challenging process. Culture is the most important element for the continuation of the core values and the participation of the employees with least resistance. Thus, the study examines the effect of digital transformation and culture on this transformation process. Information is also provided about the digital organizational culture.

5.1 Introduction

In recent years, the integration and use of new digital technologies has become one of the most urgent requirements for companies. Sectors are under a lot of pressure to make their digital transformations a strategic priority and adopt the opportunities offered by the latest digital technologies. Fitzgerald et al. defines the digital transformation of a company as the use of new digital technologies, such as social media, mobile, analytics or embedded devices, in order to enable major business improvements like enhancing customer experience, streamlining operations or creating new business models. As such, the digital transformation goes beyond merely digitizing

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resources and results in value and revenues being created from digital assets (Horlacher & Hess, 2016).

A strong and positive organizational culture is critical to promoting the sharing of skills, resources and knowledge, learning and development (Bollinger & Smith, 2001). Especially in the process of an organization adapting new practices, culture plays a very important role in encouraging members of the organization to adopt these practices. Technological innovations are seen as a challenging process by members of the organization and those who do not get tired in this process resist this period of change Digital transformation removes the barriers between people, businesses and objects that hinder businesses in every sector. Upon removing the barriers, new products and services can be created and more effective ways of doing business can be found.

Businesses make strategic efforts to increase their ability to compete more efficiently and perform IT-assisted transformations. In recent years, digital technologies have started to transform business strategies, business processes, company capabilities, products and services. These digital technologies are a combination of information, computing, communication and connectivity technologies and have become central to the transformational activities of organizations. Accordingly, companies that have undergone digital transformation make attempts to discover and use new digital technologies. This digital transformation goes beyond the digitization of resources and involves the transformation of major commercial activities, products and operations that results in advanced or completely new business models and leads to development of values and revenues generated by a company from digital assets (Horlacher, 2016).

Fitzgerald, Kruschwitz, Bonnet, and Welch (2014) conducted a very comprehensive research about managers, which showed that the business world was aware of the importance of digital transformation. However, the same managers stated that there are obstacles, such as insufficient funds, lack of vision, inadequate leadership skills and organizational culture, to digital transformation. Organizational culture is required to induce a structure to accept and adapt to change in order to support digital transformation. Transformational changes in strategy, leadership and organizational culture are needed to implement digital transformation. Successful organizations should benefit from strategy, culture and leadership to take advantage of the digital transformation potential of the business (Schwertner, 2017). Digital transformation is an important process using digital artifacts, systems and symbols within and around the organization, updating the existing culture or creating a new culture (Bounfour, 2016). According to Liebowitz (1999), 90% of the success in information management, which is the basis for digitalization and digital transformation, results from building a supportive organizational culture while developing these information management systems. Therefore, organizational culture and information technology should be addressed together. It is foreseen that organizational culture will be the basis for the realization of digital transformation in organizations.

5.2 The Steps to Digital Transformation

The path to digital transformation can be evaluated from two different perspectives. The first is the realization of the macro-based (evolution of industries) digital transformation from the micro-based (converting information into a digital format) digitization, which can be perceived as a process of the digitalization. The second point of view is that the digital transformation of developing technology becomes inevitable with the latest Industry 4.0 along with industrial evolution. The concepts of digitization and digitalization, which form the basis of digital transformation, are often used interchangeably. The terms digitization and digitalization are relatively new concepts that emerged from the development of information infrastructure and technologies that underlie the use of the Internet after the proliferation of the network (Caputa, 2017). More specifically, digitization is the conversion of a physical element from analog to digital representation in order to digitalize and automate operations or work flows (De Clerck, 2016). Digitization is a series of activities aimed at converting analog sources into an equivalent and useful digital resource. These activities include the preparation, formatting, identification and sharing of the resources; the final result might be the creation of a digital copy on the Internet for users (Caputa, 2017).

The digitization process, which enables all available information to be accessible in digital format, converts the traditional types of information storage such as written documents and photos into binary codes (1's and 0's) in computer storage devices. The expression of the data as 1's and 0's facilitates their creation, matching, compression, propagation, analysis and organization. Digitization thus allows the production of information that can be expressed in many different ways, in many different types of material and in many different systems (Brennen & Kreiss, 2014). Digitalization is "the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business" (Gartner IT Glossary, 2018).

Fitzgerald et al. (2014) gathered enterprises under four groups in terms of digitalization. The first group is beginners, which are enterprises using e-mail, Internet and various in-house software, but which are quite slow to adapt to advanced technologies. The second group is conservatives, which are non-audacious enterprises when it comes to new technologies, although they have a vision and effective structure in terms of adapting to technology. The third group is called fashionista and are very willing to adapt to new technologies. However, they are not sufficiently coordinated to be a digital business and do not have a clear vision. The last group is called digirati and have a strong vision of new technologies. They can adapt new technologies to their businesses very quickly and turn digital transformation into value. The trends of digitization and digitalization have become a significant component of competition by encouraging digital transformation initially on the basis of business, industry and global competition. Digital transformation is a change where digital artifacts, systems and symbols are used within and around the organizations (Bounfour, 2016). This process, which is the digital evolution of a business, business model, idea development process or method, must take place consciously and continuously, in both strategic and tactical dimensions (Mazzone, 2014).

The necessity of digitization and digitalization are accepted as the basis for digital transformation to take place. It is not possible for big changes such as digital transformation to occur in a very short time in both businesses and industries. There are some stages that both businesses and industries need to complete for digital transformation to take place. The success in business transformation constitutes the basis for transformation within the relevant industry. That is, the possibility of digital transformation at the industry level is proportional to the efforts of businesses for this purpose.

The emergence of the need for digital transformation has a history that goes back to the industrial revolution, which is considered to be industry 1.0. This period is called industry 1.0 or the industrial revolution, because the use of steam power in machinery significantly changed industrial production. The use of steam power, which enabled production capacities that were not possible with manpower, also had an impact on the structural and physical properties of the production areas. Since the machines of that period were quite large, problems occurred in positioning production areas (Görçün, 2016). However, technical innovations emerged in the textile industry and later in the chemical industry, which caused changes in both production and consumption patterns (Küçükkalay, 1997). The development of industrial machinery triggered major changes in production and consumption in the world, and then in the social field. Developments in some areas were milestones that still affect communication technologies today. For example, the use of the electronic telegraph by Samuel Morse in 1842 in the field of communication and Alexander Graham Bells' patent for the telephone in 1877 (Ryan, 2016) coincide with the so-called industry 1.0. The period in which binary number systems that enable digitization began to be discussed is considered Industry 1.0. Therefore, it is important that mechanization, communication and some scientific developments, which constitute the infrastructure of the digital age, date back to that period, even if it does not start at that time.

Although the exact dates cannot be specified, it is accepted that industry 2.0 started in 1870 and continued until 1989 when the east block collapsed. This is the period in which steam power was replaced by electricity and the assembly line was directed by electricity in production. The industrial use of electricity was first seen in slaughterhouses in the USA (Eğilmez, 2017). Henry Ford used this method to develop the mass production line through benchmarks, and the mass production line greatly changed the industry (Genç, 2018). The replacement of coal with petroleum in the same period brought about changes in both industrial production and transportation (Görçün, 2016). Until World War II, production and consumption continuously increased and triggered technological developments in the world. The post-World War II production stagnation and the effort to rapidly compensate for the damage to large economies led to different production and business models immediately after the war. In the 1960s, the proliferation of computers called "mainframes" that could serve thousands of users was an important step on the path to digital transformation. These computers facilitated the functions that businesses performed. In 1968, electronic chips were developed to pave the way for personal computers (Karahasan, 2012). The development of personal computers was possible when the Internet became suitable for everyone to use in 1990s. In the 1980s, personal computers were released onto the market, computer usage and information technologies became very popular in businesses as well as the proliferation of the use of e-mail. Also in the 1990s, the widespread use of integrated management software, such as the development of customer relationship management-like practices, brought about a significant change. During the same period, the surprising spread of the Internet also accelerated with businesses being part of the digital transformation (Leignel, Ungaro, & Staar, 2016). In the 1990s, www (world wide web) became widespread and businesses added to their competitiveness with their own corporate web pages (Karahasan, 2012).

Some people think that the third industrial revolution started in the early 1970s, while others consider it began with the fall of Berlin Wall. From the first point of view, the third industrial revolution started with PLCs moving automation forward in production. According to the second point of view, both the production models and the markets of the capitalist and communist economies were separate from each other in the bipolar world before the fall of the Berlin Wall. After this date, an important market emerged for capitalist economies and the balance in the world were re-established (Görçün, 2016). Along with the changing balance in the world, the efforts of industries to increase consumption considerably increased and access to international markets became easier. The production processes became more automated as computers were more involved in these processes. The outgrowth of the Internet was between 1991 and 1997. The Internet grew by 850% annually between these years (Ryan, 2016). The substantial increase in the demand and supply on the Internet is the milestone for digital transformation.

Since Industry 3.0 is the period in which breakthroughs to make production models more sustainable gained momentum, it forms the basis for the idea of Industry 4.0, which plans robotic production supported by less use of non-renewable electricity resources to dominate industrial production. Industry 3.0 did not last for a very long period. The most important reason is the introduction of a transformation called industry 4.0 in Hannover Messe in Germany in 2011. This transformation corresponds to the huge leap in industrial production which the German government transformed into a state strategy. Initiated with the aim of making Germany the smartest factory in the world with its innovative production structure (Genç, 2018), this process still continues. Although it started in Germany, all the developed economies of the world rapidly strove to catch the train of industry 4.0. The key technologies of industry 4.0, which are considered to be significant and pioneer industrial development and change in the world, have an important role in the realization of artificial intelligence, the Internet of things, machine learning, cloud systems, cyber security and adaptive robot radical changes (Sarvari, Ustundag, Cevikcan, Kaya, & Cebi, 2018). Along with the proliferation of Industry 4.0, also known as the digital industrial evolution taking hold of all industries, it will be possible to reduce human error with the development of artificial intelligence, to be able to make production in many places outside of factories with three-dimensional printers and to complete cheaper, better quality and more cost-effective production as well as providing robots which communicate with each other, can perceive media with their sensors and can analyze data to take over production (Ertuğrul and Deniz, 2018). The only way to adapt these technologies, which are of great importance for Industry 4.0, in production processes is to complete digital transformation. Developing technologies are seen to be the most important factors leading to the next evolution in industry. Accordingly, all industries evolving towards digital transformation must at least comprehend the importance of industry 4.0 and begin to position their strategies for progress to achieve competitive advantage.

5.3 The Importance of Culture in Change

According to Herbig and Dunphy (1998), culture is an all-inclusive communication system involving the biological and technical behaviors of human beings in verbal, non-verbal and written manner. Culture is the sum of a lifestyle that includes things such as expected behavior, beliefs, values, language, and life practices shared by members of a society. It is the sum of values, characteristics or behaviors shared by people in a region. Culture is a pattern of basic assumptions taught and transferred to new members of a group to create similar thoughts, feelings, perceptions and attitudes towards the same kind of situation (Kreitner & Kinicki, 1995). Managers teach culture to members of the organization through their own behavior and develop the existing culture (Lucas Jr & Goh, 2009).

Organizational culture cannot be ignored during organizational change. Organizational culture is the control of norms that show the attitudes, beliefs, assumptions and expectations of the employees in the same organization as well as the activities that determine the behaviors of individuals and the relationships between them (Akbaba, 2001). Organizational culture refers to the general judgements and behaviors of the organization and the basic assumptions that provide group learning in the solution of external and internal adaptation. Organizational culture can be expressed as the basic philosophy that shapes the decisions and practices of employees and customers. Generally speaking, organizational culture is the way in which activities are carried out in the organization or an indicator of how the organization works (Özmutaf, 2007). Organizational culture affects the way people consciously and unconsciously think, decide, and ultimately perceive, feel and act. Organizational culture has a significant impact particularly in areas such as performance and loyalty support (Lok & Crawford, 2004). Employee motivation and their cooperation trends are the determinants of organizational culture. It is necessary to understand the informal structures, processes and actual organizational culture within the organization as much as possible in order to transform organizations (Leodolter, 2017).

Organizational culture shapes organizational cognition and has an important role in organizational change. According to Barutçugil (2004), change in an organization takes place in three main dimensions:

- **Change in organizational structure:** The change in organizational structure is more related to formal organizational structure. Thus, examples include organizational rules, responsibilities, systems and processes, extent of control area, principles and rules to create a department and job descriptions of employees.
- **Change in technology:** Many elements such as the tools of the information age (computer, printer, fax, scanner, CD, DVD, flash disk, etc.) and connections (such as Internet, intranet or extranet) as well as software used in computers, other communication tools (mobile phone, television, radio) and computer-aided manufacturing systems are continuously renewed. Therefore, organizations have to keep up with technological innovations.
- **Change in human beings:** This is the change in people's behavior, knowledge and experience. As suggested by Clement (1994), perhaps the smartest way is to look for ways to work with existing culture instead of trying to change culture to transform the organization.

Organizational culture is very important for organizations existing in a constantly changing and developing environment. Organizations need to adapt to rapidly changing internal and external environmental conditions for their survival, growth and development. It is necessary to have some common values in the organization and to work within the framework of these values in order to fulfill this obligation. Changing organizational culture is a very difficult and time-consuming activity. The change in organizational culture is generally based on the aim of creating employee loyalty, increasing efficiency and productivity, and providing adaptation to the environment (Kosa, 2011). The success of change in an organization depends particularly on the adoption and acceptance of these practices by employees. The results of change cannot be expected to be positive in an organization where employees do not believe in the necessity for change. Therefore, employees' attitudes towards change should be known before starting organizational change studies. Thus, possible resistance can be prevented and planning, implementation and evaluation studies can be conducted in accordance with the attitudes of employees. It is possible to say that the success of a change process is directly proportional to the tendency of the employees of the organization and the culture that dominates that organization (Demirtaş, 2012).

It is necessary to change the organizational culture itself when it cannot adapt to changes involving either intra-organizational understanding and changes in practices (customs, ceremonies, reward systems, recruitment criteria, leaders, organizational performance, organizational growth) or non-organizational environmental changes (such as crisis situation, the presence of a new technology, increased competition, change in market share and legal changes) (Erdem, 2001).

If there is a change in the organization, the culture can be used for members of the organization to adapt to this process. An example of this is the process of creating Alibaba's organizational culture. Other companies operating within Alibaba launched a new application to create the right organizational culture. The CEO of Gem3, one of these companies, noticed that he had a connection with employees born in 1970s just like him, but there were differences between him and the younger employees born in 1990s. He found that the younger generation was not under financial pressure and paid less attention to compensation. They were more concerned about the working conditions and the organizational atmosphere, and they attached more importance to whether the company would regularly organize parties, karaoke and other team events. Then, the CEO thought, "why do we need organizational culture?" However, he concluded that even a business in which a single person was working needed organizational culture, vision and goals after training and travel were organized, because culture, vision and goals are a road map for the future efforts of businesses. A team with the right talents, skills and culture can completely benefit from technological functions and competitive advantages provided by digital transformation (Li, Su, Zhang, & Mao, 2018).

The ability of an organization to adapt to change is possible only if there is a positive attitude towards the people who constitute the culture of the organization. If an organization generally develops a negative attitude towards change, seeing it as useless and meaningless, then that organization will resist change. If so, an organization must first have a positive attitude towards people, culture and change in order to be able to change (Tokat, 2012). Schein (1996) suggests that cultural values play an important role in the environmental perceptions of managers and in structuring their opinions to determine the appropriate organizational attitude. It is considered that cultural values nourish and influence the strategy formation process, results and strategic orientations of senior executives (Fiş & Wasti, 2009). Creating a highly innovative trend, a link in the chain of change, requires an organizational culture with efforts in this direction.

Organizational culture impacts the selection of adequate organizational change management in the same way it impacts all other aspects of management. For example, if the value of flexibility dominates the organizational culture, it means that the organization members will consider change to be good and useful to the organization and to themselves. In this case, changes are likely to be continuous and thus also incremental in nature, because radical changes are not necessary precisely because they are continuous (Janićijević, 2012). As cited in Dehinbo and Alexander (2011), Kotter emphasized the need to institutionalize change in corporate culture. Two factors are important for this; first, a conscious attempt is needed to articulate how the new approaches, behaviors and attitudes are connected positively and will contribute to the success of companies. Secondly, in order to avoid future leaders eroding the gains achieved, it is important to ensure leadership development in order to guarantee succession of new leadership that embodies the new approach. Change creates uncertainty within an organization. Emphasizing the values of an organization, in particular how change will improve these values, strikes at the very heart of those within the organization and makes them more open to change and accepting of it. Any attempt at change within the organization can be seen as a threat to culture and the identity of the employee. The challenges of the culture in an organization are met by strong and immediate resistance (Martin, 2013).

Organizational culture plays a key role in managing change. Because organizational culture helps the organization, it plays a key role in the existence of the organization and ability to adapt to internal and external demands. The organizational culture promotes confidence, resistance to change and neutralizes external threats (Onyango, 2014). It is believed that an organization's culture should be aligned with its strategy and that when the strategy changes managers should ensure that the culture changes if it needs to. The construct of change readiness as a cognitive phenomenon is an important facet of organizational culture (Smollan & Parry, 2009).

Organizations are becoming more and more aware of the importance of digitalization in order to gain power and maintain their existence while preparing themselves for the future. They work on what to do and which steps need to take, thereby clarifying their road maps and preparing projects. As a result of all this work, it is important that the organizational cultures are structured accordingly and the applicable culture codes in the environment are understood correctly so digitization can be successful. The existing culture should be analyzed correctly and the current situation should be understood correctly (Aksu, 2018).

The development of digital technologies, such as artificial intelligence, big data and the Internet of Things, requires all members of an organization to be ready for digital transformation and to be open and transparent. However, in the digital age, managers can easily underestimate the influence of culture. In an evaluation of 40 digital transformations, it was found that only 17% of companies that ignored the working culture saw improved financial performance. In the meantime, nine out of ten companies focusing on digital culture observed significant increases in financial performance, while 80% of organizations promoting digital culture reported breakthroughs as a result of the transformation (Schrieberg, 2018).

5.4 Building Supportive Culture in Digital Transformation

European companies are increasingly using Internet technology to transform their value chain activities. So, the Internet-based digital or electronic business (e-business) is considered to be one of the most important information technology innovations in the last decade (Geoffrion & Krishnan, 2003). In recent years, cross-border technologies such as e-commerce and social media were rapidly and widely adopted by companies. Such transformations driven by non-organizational-oriented information technologies are much more effective than changes in the internal business processes of organizations. These transformations in the digital area require serious changes in business models, organizational strategies, culture and operation processes (Li et al., 2018).

Many researchers agree that organizational culture is a socially learned and transmitted phenomenon at group level. Supportive culture generally represents the core values of businesses and uses operational procedures to meet the needs of employees, to maintain human relationships and to show people that they are cared about (Sok, Blomme, & Tromp, 2014). According to the organizational culture literature, there are many factors affecting organizational transformation. Particularly, one of the most important factors is that employees accept this transformation and are involved in the process of change to support it (Michela & Burke, 2000).

Because its style is based on humanistic principles, a supportive culture involves teamwork and a people-oriented, friendly, encouraging and trusting work environment that increases the likelihood that employees will feel comfortable using friendly advantages such as flextime, as they are less likely to worry about possible negative career consequences (Liou, Tu, & Chang, 2014).

Leaders who are supportive understand and sense how other people feel. By showing authenticity and a sincere interest in those around them, they build trust and inspire and help colleagues to overcome challenges. They intervene in group work to promote organizational efficiency, allaying unwarranted fears about external threats and preventing the energy of employees from dissipating into internal conflict (Feser, Mayol, & Srinivasan, 2015). Leadership plays an important role in the successful adoption of digital technology (Li, Liu, Belitski, Ghobadian, & O'Regan, 2016). It is more difficult to change an organizational culture than to maintain it, but effective strategic leaders recognize the need for change. Regardless of the reasons for change, shaping and strengthening a new culture, effective communication and problem solving together with the selection of the right people, efficient performance assessment and a valuable reward system are required. Experience shows that success in any cultural change depends on active support from the Chief Executive Officer and other senior managers. One useful approach for leadership is to make special efforts to encourage, nurture and support people who want to promote new technologies, new practices, better services, new products and new applications (Eromafuru, 2013).

Crucially, such an important transformation requires the support of the entire staff—the digital transformation will fail without a change in how people work and act. Indeed, culture is the responsibility of the whole company (Schrieberg, 2018). To encourage staff and executives to support digital transformation, they should own it. This isn't something that's going to be handed to them by IT and they need to understand that. Management should repeat the message frequently and managers throughout the company should have mechanisms to work together to drive and direct the change. Their overall performance must be evaluated in part by their support for digital transformation and their reports (Kisovec, 2018).

Organizations which undergo technology-driven changes should know technology is only one of several interrelated components that guides organizational performance. A multi-system perspective emphasizes the relationship between technology, structure and culture of an organization, and how they affect organizational processes and behaviors. Successful technological innovations require either the design of technology to comply with the existing structure and culture of the organization, or the reshaping of its organizational structure and culture to suit the demands of the new technology. Supportive culture can be a major problem in transferring technology, designing systems with culturally diverse teams or distributing systems for users from different cultural environments, in terms of technology design and implementation. Whether or not the intended results are achieved by technological transformation depends, in part, on whether the behavioral requirements are compatible with the current culture or if the current culture can be altered to comply with these requirements. It is not easy to combine technology and culture because both concepts also interact with the subsystems of the organization. It is necessary to have a supportive perspective in order to adapt the culture to this technological transformation (Cabrera, Cabrera, & Barajas, 2001).

Organizations must fulfill certain conditions in terms of their internal behavior and external relations in order to successfully adopt and implement technological transformation. Moreover, culture should be considered as an area of operational competence, which shapes organizational transformation. Cultural aspects and management behavior are closely related and are a serious obstacle to change unless they are properly supported (Naranjo-Valencia, Jiménez-Jiménez, & Sanz-Valle, 2011). The biggest problem in managing change in organizations arises from not fully understanding the depth and power of culture (Schein, 1999). Unlike national and professional cultures, organizational culture can be changed at least to some extent. When an individual begins working in an organization, their national and professional cultures also penetrate that business. Being aware of this situation can help to better manage technological innovations. This potential manageability of organizational culture should be taken into account especially in terms of implementing technology-driven change (Cabrera et al., 2001).

Gordon (1991) observed that the culture of an organization is a product that successfully adapts to the environment and as a result can support change. He also pointed out that these changes, including learning new things, may also involve the need for new people, and that changes in culture may be necessary. The idea of planned organizational change is an integral part of the field of organizational development. The concept of organizational culture is an important factor in this planned change process. This is evident in the development frameworks, which explicitly depict culture as a subsystem of the organization or implicitly picture it, for organizational purposes and relations. Heracleous (2001) indicates that changes are likely to fail in organizations where culture is ignored and there is no supportive understanding, arguing that it is mandatory to understand organizational culture and adopt supportive behavior in order to achieve successful organizational change.

The change processes of organizations are always painful. The issue of digital transformation, especially, is seen as a great struggle for managers and employees who are not interested in technology. In such cases, this initiative fails if there is someone who does not support the transformation and resists this process. The following example explains this situation. In the case study by Strategy (2013), Peter saw it as an exciting challenge when he decided to undertake the task of developing new digital sales and marketing channels at a traditional European retailer. The company had a good reputation and the new website was an online portal with innovative social media features. The company had not yet actively integrated its analog and digital sales channels and had not yet achieved strong performance levels in online marketing. However, its senior management visited online retailers with the latest technology, including Zappos.com, and understood what the future may bring. Peter and his team started working on changing advertising budgets and other processes to focus on online sales. However, after 18 months, they found that they are still intensively using the traditional sales channels, which make up more than 80% of the company's revenue. Department managers avoided change and senior management did not support change. As a result, digital transformation unfortunately did not happen. This case study (company and individual names kept confidential) is a typical example of how organizational culture can interfere with the transition to digital identity. Now that digital technology has changed the rules, competitors who play the game according to these rules gain advantage. However, Peter's non-supportive organizational culture did not allow him to compete in this environment.

It is not enough to know what the desired organizational culture looks like. Organizations need to develop plans to make the desired organizational culture a reality. Executive support and training are the two most important elements to bring about organizational cultural change. Managers must support change beyond verbal approval. They must demonstrate support for cultural change by changing their behavior (Heathfield, 2018).

Changes in the organizational culture are difficult to achieve, especially if efforts are not systematic and are planned in the end. When planning for any major change that will have a significant impact on organizational members, it is best practice for leaders to use the principles of change management in the planning process. This increases the probability that the change will succeed by helping members to understand the reasons for the change and by encouraging positive organizational support for the change. When deciding to make a concerted effort to change culture, the planning should be no different. Since the culture of each organization is steeped in traditions, customs and practices and is naturally extremely difficult to change, it is crucial to apply the principles of change management early in the planning process (Mierke & Williamson, 2017).

According to McKinsey's report (2016), culture is the biggest challenge when it comes to digital transformation. In a survey conducted with 2135 people, 33% of participants stated that they experienced most cultural and behavioral difficulties in digital transformations (Manyika et al., 2016). Research by Capgemini (2017) showed that 19% of participants answered the question *"What is the biggest difference between working in a digital business environment versus a traditional one?"* as *"culture and mindset"*. In research by Kane, Palmer, Phillips, Kiron, and Buckley (2018), 80% of participants stated that they supported the changes and transformations of the organizations they work in and used the expression *"My organization encourages feedback and iteration to learn how to work in new ways"*. According to the same study results, 29% of the participants answered the question *"What's the biggest challenge your organization faces with respect to collaborating effectively?"* as *"culture"*.

5.5 Digital Organizational Culture

Digital transformation is a highly promising and challenging process to create new business models, improve business processes and change the way real-time information is used. Although the need to adapt to the digital environment is inevitable, it is not certain that such a change will create value for the organization. Therefore, it is necessary to investigate how such a process can be managed successfully in an organizational environment and to determine the effect of cultural elements in adapting to technological change. Culture determines the challenges and potentials of digital transformation. If cultural problems arise, even the best-designed digital strategy of the organization can fail in this transformation process. Cultural and cultural elements are the primary challenge for organizations to be successful in digital transformation (Oswald & Kleinemeier, 2017). For this reason, organizations should adapt their culture to this process and create a culture of digital transformation in order to make the processes of digital transformation sustainable.

A digital culture is characterized by the sharing of information and knowledge between the various stakeholders in an organization in order to create a collective intelligence that creates value for the company (Bounfour, 2016). Digital culture refers not only to values, agreements, and ideas in society today, but also to how people communicate in society (Ertem-Eray, 2019). It is a term to describe the changing relationship between the creation and consumption of culture and the impact of new information technology on this changing relationship (Giovanelli, 2019). In short, it is a new culture formed by digitalization. The digital term in digital culture is used for electronic systems which store, process and transmit digital speech as a digital sequence (Türkoğlu & Türkoğlu, 2019). Digital culture represents a clear and almost complete digital technology transformation of the world. It is frequently used by movements that have advocated on issues ranging from practical hackers and digital to independent music and the economy of solidarity (Botelho-Francisco, 2016). A digital culture typically has five elements that are defined as follows (Hemerling, Kilmann, Danoesastro, Stutts, & Ahern, 2018):

- It promotes an external, rather than an internal orientation.
- Delegation is awarded over control.
- Favors boldness over caution.
- It highlights more action and less planning.
- Collaboration is valued more than individual efforts.

According to Capgemini's report (2017), creating digital culture is a very challenging process. It is a long-lasting effort that requires patience, determination and constant attention. Organizations need to be motivated to unite, empower and inspire employees to build cultural change together in order to create a digital culture. First companies should tangibly change digital culture. A systems-thinking approach should also be taken to change culture. For example, organizations will struggle to launch an innovation culture by establishing an innovation center alone without the support of multiple complementary behaviors, innovation and collaborative thinking, or partnership approaches to start-up work. This approach depends on making several changes simultaneously so that the organization develops by strengthening behavioral loops. Leaders must recognize digital transformation as the fundamental and strategic change in the paradigm. Like any major transformation, digital transformation requires the creation of a culture that supports change and enables the overall strategy of the company. The integration of a digital culture into an organization is feasible, but a clear methodology and disciplined effort are required. Before we describe the critical moves companies must make to develop a sustainable digital culture, let's first examine the reasons why it is so important to have a digital culture (Hemerling et al., 2018).

It is possible to exemplify the transformation program of the Enel Group as a process of digital culture. In 2015, a digital transformation program was launched by Francesco Starace, General Manager of Enel Group. "*Digital culture should be internally supported and sustained"*. The lack of employee participation in the digital transformation project launched in Enel Italy in the summer of 2015 was often the biggest obstacle in this transformation process. Therefore, the main objective of the project was to identify employees with above average digital skills and thus to encourage them to put up less resistance to digital culture. At the end of this project, the new environment was created not only using technology to promote innovation and enable digital transformation in Enel, but also by transforming the business culture and processes, developing solutions that were adopted to the current conditions of the digital economy and transform the information systems accordingly (Bongiorno, Rizzo, & Vaia, 2018).

Bounfour (2016) suggests that digital culture is formed through a collective work process that creates value by sharing effective information among the members of the organization. Furthermore, he emphasizes that cultural approach should be noted in this process and states that the organizational culture has a direct effect on the use of information technologies. Digital transformation can only be successful if it is supported by an IT-oriented organizational culture. This process therefore must be carried out with human capital ready for difficult change. Digital transformation management should prepare the necessary conditions for the introduction of this digital culture (Leignel et al., 2016). Digital culture consists of the creation of a system of evolving values and a set of expectations by online users as well as information and content by users (Deuze, 2006). Digital culture, a complex structure, includes the following areas (Rab, 2007):

- Technical equipment such as computers, mobile phones, digital cameras, and modern televisions required for access to digital culture.
- Cultural elements created on digital platforms or digitally created ones.
- Digitalization (digital design of cultural elements, online content and users play an important role in the digitalization process).
- Accessibility to information. As a result of the lack of Latin literacy required to reach the information society in the early modern age, societies were deprived of a variety of dialogue in seeking rights and services. Digital culture created an important and sufficient value for transformation into an information society thanks to its accessibility.

It is difficult to change organizational culture and individual behavior without encouraging new working methods based on digitalization. Organizations should therefore develop a high-performance culture around themselves. Culture can be another major obstacle to the path to digital transformation. Thus, the following questions need to be answered during this transformation period (Schreckling & Steiger, 2017):

- Does the current culture facilitate digitalization?
- Is the current culture suitable for change?
- How can a new organizational culture be created with a new perspective on digital technology?
- How is the initial atmosphere for digital transformation?
- How can information storage be integrated with information sharing?
- How is a service- and customer-oriented culture promoted?
- How is a data-driven culture established?
- How can a culture of security and respect for privacy be created?

Table 5.1 presents the characteristics of digital culture. In the light of these features, digital culture is seen not as a one-way process. It is necessary that the components of customers and demand, organization, attitudes and ways of working should come together and be harmoniously involved in the process in order to create a successful digital culture in organizations. Organizations that were established before digital transformation should adapt their organizational cultures to digital transformation in order to keep up with today's digital world. Each of these five key practices focuses on one aspect of organizational culture. This is an indication of the importance of culture in the ability of a company to adopt new business methods and practices. The digital organizational culture created reflects the deepest and most connected beliefs and values of an organization.

Table 5.1 Features of digital culture

Customers and demand	• Pulls ideas from the market • Driven by customer demand
Organization	• Flat hierarchy • Rapid decision making • Result and product orientation • Empowered employees
Attitudes and ways of working	• Understands needs of digital customers and how to adopt new trends • Orientation toward innovation, improvement, and overcoming constraints • Potential, vision, curiosity, motivation, flexibility, and adaptability count • Mixed teams working in cross-functional and integrated communities • Strong collaboration • Rapid, unpredictable career progression • Focus on rapid launch and learn

Source: Harshak, A., Schmaus, B., & Dimitrova, D. (2013). Building a digital culture: How to meet the challenge of multichannel digitization. *Booz & Company, Strategy&, pwc*, *1*, 1–15

5.6 Conclusion

Managers need to take a proactive stance on culture and adopt a culture that supports this process for digital transformation to take place successfully and rapidly in organizations. Leaders cannot achieve the speed and agility they need in their digital transformation effort unless they build customer-oriented organizational cultures that display good performance and take care of risks. An ecosystem that fosters learning, experimentation and growth needs to be established. Organizations can turn their digital culture identities into a significant competitive advantage if they plan early and establish specific objectives during the process of digital transformation. Today, it is impossible for organizational structures with the features of open system to escape change. Thus, the survival and development of corporate organizations can only be ensured as a result of their positive integration to change. Both the impact of globalization on many dimensions which includes global norms such as quality, management, product, service, process, understanding and technology, and the rapid change in information technologies leads the senior management in businesses to establish new strategies accordingly. Digital transformation is a highly effective and challenging process for improving business processes and creating new business models. The need to adapt to the digital environment is inevitable and this change provides a very important competitive advantage for the organization. Therefore, it is necessary to investigate how such a process can be managed successfully in an organizational environment and to determine the effect of cultural elements in adapting to technological change. Digital transformation can only result in success as long as it is supported by a technology-oriented culture. Thus, this process should be carried out with enthusiastic employees who participate willingly.

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Part II
Digital Transformation of Business Operations in the Blockchain Ecosystem

Chapter 6
Digitalization of Business Functions under Industry 4.0

Melissa N. Cagle, Kevser Yılmaz, and Hümeyra Doğru

Abstract Despite the literature's support that the main function to be affected by the Industry 4.0 movement will be the operations function, the rapid incorporation of new technologies under firms promises to affect each departments of the business dramatically. This chapter aims to highlight the role of each function within Industry 4.0. Moreover, the chapter will determine the actualized benefit of transitioning towards Industry 4.0, separate from the recognized benefits under the literature. In order to achieve this a content analysis was conducted on the 2017 annual activity reports of manufacturing firms listed on the Istanbul Stock Exchange (BIST). Out of the 178 listed manufacturing firms under BIST, only 20 were identified as transitioning towards Industry 4.0. Out of these 20 firms, 16 firms' annual activity reports mentioned transitioning towards Industry 4.0 and addressed the outcome (benefits) of the applications. Items were subjected to a content analysis based on business functions (Theme 1), sub-categories of business functions (Theme 2) and the common actual benefit (Theme 3) by three different researchers. The unit of analysis, the identified benefits, were 232 items in total and spread across the operations (41%), strategic management (Cost and Competitive Advantage) (22%), technology and process development (15%), procurement and distribution (12%), human resources (8%) and marketing (2%) business functions.

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6.1 Introduction

The new Industrial Revolution, announced in 2011 at the Hannover Fair, initially began its integration into business functions through operations such as; accurate prediction of failures, effective production processes, enhanced planning and management activities (Rüßmann et al., 2015), however, it has now become a part of all core business functions. Throughout vertical and horizontal system integration (Varghese & Tandur, 2014) the business functions have evolved from "raw materials acquisition" (Siemens, 2016) all the way to marketing, logistic, accounting, finance and customer relations. Recently, the Turkish Government launched a project-based incentive system in order to accelerate the shift towards Industry 4.0 under manufacturing firms. This creates a motivation to analyze current Industry 4.0 application levels and their implementation activities of the initiative. This study aims to contribute towards creating an understanding of the usage and effect of the Industry 4.0 transition overtaking the business world. As a result, we shall conduct a content analysis on the annual activity reports of the manufacturing sector companies listed on BIST. Kaldor (1957), describes the manufacturing industry as "the main engine" responsible for transforming demand into "growth". Examining the relationship between national industrial development and economic growth, he argues that there is a strong positive correlation between GDP and industrial activity.

The above argument, coupled with the fact that (1) Industry 4.0 development is expected to largely target industrial production (Strandhagen, Alfnes, Strandhagen, & Vallandingham, 2017), and (2) emerging technologies can have an impact on manufacturing approaches and businesses (Zhong, Xu, Klotz, & Newman, 2017) is motivation for including manufacturing firms under the sample. The activity reports were selected for the analysis as they provide audited information on the current and future activities of the organization. Under the analysis we downloaded and examined the 2017 annual activity reports of all manufacturing firms listed on the exchange. The reports were subjected to a content analysis to generate information on firms' Industry 4.0 benefits in relation to the evolving business functions. The analysis was conducted by three coders simultaneously and each item was discussed before being coded in order increase the validity and reliability of the study. As revealed from the annual activity reports of BIST listed manufacturing firms, the chapter identified that, out of each business function, the strategy and operations functions have benefited extensively from the Industry 4.0 revolution. Moreover, the least affected business functions were marketing and human resource management. The remainder of the study is as follows. Section 6.2 provides a literature review on the developmental stages of Industry 4.0 and its role under each business function. Sections 6.2.3 and 6.2.4 details the research design, while Sect. 6.3 discusses the findings. Finally, Sect. 6.4 concludes.

6.2 Literature Review

6.2.1 *The Stages of Development for Industry Revolutions*

Humanity has transitioned through four different industrial revolutions. The first industrial revolution began with the invention of machines in end of the eighteenth century (Kagermann, Helbig, Hellinger, & Wahlster, 2013). With the usage of steam power and engine in production, the door was opened for quicker and cheaper production (Allen, 2006; Jensen, 1993). Production areas evolved, and small workshops shifted transformed into factories (Drath & Horch, 2014). The first industrial revolution initially began in the Great Britain region due to the high wage rate, energy value, availability returns on inventions, and finally, the size of the current mining industry and legal rights of the inventor (Allen, 2006). Upon reaching this technological breakthrough, legal protection for workers increased. Moreover, as returns increased on investments, business owners were able to generate higher income to cover costs. This development reduced high wage rate for businesses by replacing most workers with machines (Allen, 2006). The core characteristic of the first industrial revolution was mechanization (Kagermann et al., 2013).

With the invention of these new machines, usage of steam and water power in manufacturing triggered increases in productivity (Allen, 2006; Deane, 1979; Küçükkalay, 1997; Voigtländer & Voth, 2006). The industrial revolution began within the manufacturing field, however their effects soon exceed the production areas and encompassed society as a whole. Even the population structure was not left unaffected. Citizens started to move to urban areas to work in factories (Blinder, 2006; Deane, 1979; Labor, 1990). Thus, the population (Deane, 1979; Tezge, 2010), living standards of people and (Jensen, 1993) aggregate welfare increased (Jensen, 1993). Contributing towards the betterment of society in the long run.

The second industrial revolution, now referred to as Industry 2.0, began towards the beginning of the twentieth Century due to increased electricity usage in manufacturing (Atkeson & Kehoe, 2001; Kagermann et al., 2013; Rosenberg, 1998). Developments such as the usage of petroleum, chemicals, high explosives, telephones, and radios also signified the shift in the second industrial revolution age (Atkeson & Kehoe, 2001; Mokyr, 1998). Access to steel in the production area ultimately decreased production costs and in turn, increased the quality of products (Mokyr, 1998). With goods being shipped across the Atlantic to America directly, this opened the door for global trading and new alternative markets. Additional railroads were built, making the transportation of goods across long distances easier, subsequently decreasing costs (time and expenses) (Engelman, 2015). Taylorism principles were later incorporated into manufacturing factories. Assembly line, electrically powered mass production and division of labor spurred important breakthroughs in manufacturing (Blanchet, Rinn, Von Thaden, & De Thieulloy, 2014; Drath & Horch, 2014; Mokyr, 1998). In the second industrial revolution, cost of production decreased and productivity (Atkeson & Kehoe, 2001), while production increased (Boyd & Crawford, 2012; Kagermann et al., 2013; Paul & Jonathan, 1991). Moreover, with the inventions of synthetic plastic, the core material employed for products shifted into plastics (Mokyr, 1998).

The second industrial revolution also affected the lives of citizens. With usage of steel in ship production, ships became more powerful and moved faster. People started to traveling long-distances to geographic areas, moreover interaction of people increased with new inventions; radios, telegraph and telephones (Atkeson & Kehoe, 2001; Engelman, 2015; Mokyr, 1998). Social welfare, living standards, and the incomes of people increased (Engelman, 2015; Mokyr, 1998). Growth rate of the service industry increased due to changes in consumer preferences (Blinder, 2006). Moreover, fertilizers, chemicals and tractors were employed in the agriculture, which improved the amount of harvest, and decreased cost and time loss (Mokyr, 1998). Finally, countries became more interdependent and globalized.

The third industrial revolution, referred to as, Industry 3.0 began in the 1970s. Automation and information technologies (IT) became the core elements of the Industry 3.0 (Blanchet et al., 2014; Jazdi, 2014). In 1969, programmable logic controllers were invented, which allowed employees to digitally program the automation systems (Kagermann et al., 2013). Diminishing usage of fossil fuels and climate change were the main triggers of the third industrial revolution age. Sustainable growth and renewable energy topics became the focus of discussions by political leaders and company managers (Jänicke & Jacob, 2009; Rifkin, 2013). Invention activities continued during the third industrial revolution, high-speed railroads systems, inventions of the internet, fiber optic, satellite, cellular phones are a few examples of inventions during this age (Jänicke & Jacob, 2009; Jensen, 1993). Not unlike the first two industrial revolutions, the third industrial revolution too brought about affirmative outcomes to manufacturing. More flexible and efficient production systems became possible through applications of automation (Kagermann et al., 2013) and controlling robots in production (Schmidt et al., 2015). Radio Frequency Identification Device (RFID) technologies gave the change for using product tracking programs during transportation and remotely controlling products in warehousing (Brettel, Friederichsen, Keller, & Rosenberg, 2014). Moreover, companies started to develop prototypes of products more easily, due to additive manufacturing technology (Gibson, Rosen, & Stucker, 2015). Usage of information Technologies expanded and the service industry still maintains this development and growth (Blinder, 2006).

The final form of the industrial revolution is Industry 4.0, and the topic of this chapter. This fourth industrial revolution, was launched by the German Government in 2011 (Kagermann, Lukas, & Wahlster, 2011). Industry 4.0 is referred to with various different names, depending on the region. For example, "Industrie 4.0" in Germany, "Internet of Things (IoT)" in European Union countries (Kagermann et al., 2013) and "Made in China 2025" in China (Liu, 2016). Furthermore, Japanese use "Society 5.0", which is the integration of Industry 4.0's developments and society (Wang, Li, Yuan, Ye, & Wang, 2016). Not unlike other governments, Turkey also attaches great importance to Industry 4.0. In 2016, TÜSİAD (Türk Sanayicileri ve İşinsanlari Derneği—Turkish Industry & Business Association) published a report titled "Industry 4.0 in Turkey as an Imperative for Global

Table 6.1 Core characteristic of industrial revolution stages

Industrial revolution stages	Core characteristic
Industry 1.0	Mechanization (Kagermann et al., 2013).
Industry 2.0	Usage of Electric (Atkeson & Kehoe, 2001; Kagermann et al., 2013; Rosenberg, 1998)
Industry 3.0	Automation and information technology (IT) (Blanchet et al., 2014; Jazdi, 2014).
Industry 4.0	Cyber-physical systems (Kagermann et al., 2013; Rajkumar et al., 2010)

Competitiveness-An Emerging Market Perspective" regarding the national position and vision on the movement (Tüsiad, 2016).

The Industry 4.0 concept can be defined as flexible control of manufacturing systems via usage of cyber-physical systems (Kagermann, 2015). Cyber physical systems create a relation between the real and computer oriented world and all systems and devices can be monitored, coordinated and controlled without any stable control central (Rajkumar, Lee, Sha, & Stankovic, 2010). Moreover, information can be exchanged between the real and virtual world in real time (Kagermann et al., 2013) by computing and communication infrastructures (Baheti & Gill, 2011; Rajkumar et al., 2010; Schmidt et al., 2015). Technological developments in Industry 4.0 brings fast, disruptive and destructive (Blanchet et al., 2014) changes and effects the production fields (Ganzarain & Errasti, 2016; Kagermann et al., 2013; Rüßmann et al., 2015; Schmidt et al., 2015). It allows for better control and arrangement of manufacturing systems (Industrial Internet Consortium, Fact Sheet, 2013), real-time optimized flexible and dynamic systems (Kagermann et al., 2013) and so on. However, technological developments of Industry 4.0 do not just affect the production areas, but also other business functions (Blanchet et al., 2014). Table 6.1 summarizes the information on the main core characteristics of the four industrial relations stages.

In the following section, the impact of Industry 4.0 on operations, strategic management (Cost and Competitive Advantage), accounting, finance, marketing and human resources management will be explored.

6.2.2 Industry 4.0's Role under the Business Functions

Strategic Management (Cost and Competitive Advantage) With the integration of Industry 4.0 under businesses, firms will slowly extend operations and become more large-scale (Kagermann, 2015; Rüßmann et al., 2015), increasing the level of competition (cost or otherwise) between transitioning and non-transitioning firms (Blanchet et al., 2014). The integrated technology will allow for more individualized production (Lasi, Fettke, Kemper, Feld, & Hoffmann, 2014; Rüßmann et al., 2015) and even contribute towards increasing customer trust levels for organizations

(Byres & Lowe, 2004). However, despite the professed multiple benefits of Industry 4.0, the current literature lacks coverage of these cost/financial and/or competitive advantages. Addressed under the strategic management function of businesses, these benefits are capable of setting the Industry 4.0 transitioning firms separate from the competition. By use of artificial intelligence programs and collected organizational data, the firms will be able to conduct accurate planning, organizing and evaluating tasks (Kagermann et al., 2013) in real and virtual environments. This information will be communicated by machines/systems to within/outside of the factory/stakeholder (Lasi et al., 2014; Rüßmann et al., 2015). These systems and the communicated information will allow managers to efficiently allocate and use resources (Jazdi, 2014), faster/supported decision making (Kagermann et al., 2013). Each function/activity within the business will be better coordinated, creating a clear corporate strategy (Kagermann et al., 2013). These integrated systems will ensure that the firm creates and sustains their competitive advantage (Stock & Seliger, 2016). Furthermore, the innovation speed within businesses will increase (Jazdi, 2014), and usage of smart systems will bring new advantages for companies boundaries (Schuh, Potente, Wesch-Potente, Weber, & Prote, 2014)—increasing value creation and evolving business models (Jazdi, 2014; Kagermann et al., 2013; Rüßmann et al., 2015; Schuh et al., 2014).

Regarding the firms financial/cost advantage; increased production quality (quality enhancements) (Industrial Internet Consortium, Fact Sheet, 2013; Kagermann et al., 2013) will lead to an increase in demand, and consequently, increase in sales volume (McAfee, Brynjolfsson, Davenport, Patil, & Barton, 2012). Similarly, the following of new production trends will positively affect the financial bottom line. Improved quality will also aid in reducing manufacturing cost. Whether its preventative maintenance or production/operation costs per produced unit (Manyika et al., 2011). Preventative maintenance will also have the benefit of reducing machine breakdown, subsequently cutting back on associated losses; such as, loss of customer or electric expenses (Kagermann, 2015). Highly automatized production will also reduce the need for manpower on the production floor and online control/maintenance systems will reduce manager work-flow. Finally, repair expenses will go down as regular and monitored maintenance is conducted on new machinery. With increased level of communication between sales and production, the risk of unfulfilled orders will reduce and planning activities regarding raw material purchase and in-house transportation will become automatized (Lee, 2008). The ordering of new products and supplier communication will run smoothly, inventory/storage costs will reduce as smart factories will allow for optimized inventory management (Varghese & Tandur, 2014). New technology and increased monitory will reduce waste production, cutting back overhead costs. Finally, an optimized production process will allow for cutting back utility costs, such as, electricity and water. These items are a brief example of the benefits of transitioning towards Industry 4.0 and its effect on the cost and competitive advantage of firms.

Operations, Procurement and Distribution One of the important benefits of Industry 4.0 is enhancing productivity (Ganzarain & Errasti, 2016; Kagermann, 2015;

Rüßmann et al., 2015), while the shop-floor of firms is the most affected area from transitioning to Industry 4.0 (Schuh et al., 2014). Industry 4.0 promises to benefit the productivity of operations through improved product development process (Kagermann et al., 2013), increased production speed/quality and lower defects and repair issues (Abbott, 2014; Kagermann, 2015). Moreover, these adaptations will enhance performance of engineering (Schuh et al., 2014) and usage of digital twin technology. A manager will be able to use an application to upload products to transport vehicles, whether or not they are physically located in the factory. They will also be able to makes changes or modifications in a virtual environment, observe these changes online and have access to information about possible problems (as it occurs) (Fiorentino, de Amicis, Monno, & Stork, 2002). However, it is also argued that an increase in the speed of innovation has led to a reduction in the production life cycle (Schuh et al., 2014). Furthermore, production systems can be controlled remotely/digitally, allowing the systems to become more flexible. This provides workers with the ability to make last minute configuration and produce more individualized products (Kagermann et al., 2013).

The other advantages of Industry 4.0 is the increased connection and communication of machines (Lasi et al., 2014; Rüßmann et al., 2015) through cyber-physical system. Moreover, the quality of production (Industrial Internet Consortium, Fact Sheet, 2013) and repair and defects cost (Varghese & Tandur, 2014) are several areas that will be affected positively due to the integration of smart systems. All systems will be integrated and will be open for in-house communication. These systems will be able to detect deficits or quality issues, which will allow them to take immediate action via use of artificial intelligence software- increasing the efficiency and effectiveness of factories (Industrial Internet Consortium, Fact Sheet, 2013; Rüßmann et al., 2015).

Connection and communication between supply chain members will improve with these new technologies, such as; internet of things and cyber-physical systems. Thereby, planning, ordering and transportation activities will be performed in more efficient ways by supply chain members. Thus, managers will be able to easily manage their supply chains (Kagermann et al., 2013). Besides supply chain management, logistics and transportation activities will be affected positively with the new technological developments. Some logistics and transportation decisions such as routes selection, controlling will be overtaken by smart systems. For example, all traffic lights will be connected each other, so that systems more efficiently create a transportation routes for truck (Kagermann, 2015). This will reduce the workload of human workers.

Finally, energy efficiency is one of the final benefits afforded by Industry 4.0 (Kagermann et al., 2013). With the help of "start-stop features" of machines and systems, the period of production breaks will decrease. Smart systems and robots dramatically reduce usage of energy, as 90% of energy expenses are consumed during production breaks (Kagermann, 2015).

Technology and Process Development Digital manufacturing, network communication, computer and automation technologies are some of the technologies that are required for the effective implementation of the fourth industrial revolution (Zhou, Liu, & Zhou, 2015). With "cyber-physical systems and internet of things" technologies, all devices and systems will be able to automatically collect, analyze and interpret data. Moreover, these systems will be able to send and receive information from other devices and services. Data will be collectable through smart objects and systems, referred to as big data. However, this will also result in new emerging problems; such as, analyzing large data sources (Blanchet et al., 2014), organizing complicated data (Chen, Mao, & Liu, 2014; Wu, Zhu, Wu, & Ding, 2014), data storage (Manyika et al., 2011) and data protection (Blanchet et al., 2014). These issues need to be resolved in order to ensure efficient transition towards Industry 4.0. These technologies will not only contribute towards operations, but will also positively affect the business' reputation and image (Byres & Lowe, 2004).

Cyber-security and data protection are seen as a core requirements of implementation of Industry 4.0 (Kagermann et al., 2013; Rüßmann et al., 2015) because without data protection, effective integration of production systems/networks will not be possible. Hold backs resulting from fear of hacking will reduce firm willingness to share information, reduce connection/communication between activities (for smart objects, firms, stakeholder and customers). Service/product design also promises to be affected from technological development. For example, design of product can be made more flexible and easy with using high technological programs (Kagermann et al., 2013). Moreover, customers and stakeholders can be involved in production process through selecting the components to distribution phases (Blanchet et al., 2014). Also, 3-dimensional virtual objects (Paelke, 2014) give change to observe changes immediately without need to manufacture prototype (Fiorentino et al., 2002).

Marketing New technological systems, referred to as embedded systems, give the ability to record, store and process data. With the integration of Industry 4.0, embedded systems will become more commonplace for firms/technology. All objects will, in time, be equipped with sensors/actuators, which will allow for them to easily connect to the internet, collect and analyze data (Kagermann, 2015; Lasi et al., 2014; Rüßmann et al., 2015). Production systems will become more flexible (Shrouf, Ordieres, & Miragliotta, 2014) and last-minute changes will become possible (Kagermann et al., 2013). Finally, different types of products will be more easily produced than before (Brynjolfsson, Hofmann, & Jordan, 2010). This will also prompt the integration of consumers within the production systems.

The control of consumers (on products) will increase in the fourth industrial era. These individuals will determine components and ingredients of products based on their wants and needs (Blanchet et al., 2014: 9–11) and access more information on the product life-cycle (Jazdi, 2014; Stock & Seliger, 2016). Production will shift from mass customization to individualized production due to increased flexibility (Kagermann et al., 2013; Lasi et al., 2014; Rüßmann et al., 2015).

Customers will be able to reach more detailed information about products; such as when/where it is produced, how it is produced, ingredients of products. This will be possible due to unique product coding. Personalized medicine is one example for individualized production. These products are prepared based on patients' needs (Kagermann, 2015), taking into account the patients unique physical conditions. Industry 4.0/Internet of Things technology has allowed for the storage and analysis of consumers' preferences. Thus, comprehensive and continuous information about consumers can be accessible by marketers (Kagermann, 2015). Thus, the marketing function of businesses will be affected by the developments of fourth industrial revolution. With access to more detailed information about customers, the segmentation of the market and target customer selection will become more accurate.

Human Resource Management With cyber-physical system, capabilities, abilities and functions of Artificial Intelligence and robots will be integrated in production, in turn affecting the employees work in the factory (Blanchet et al., 2014; Kagermann et al., 2013; Rüßmann et al., 2015). Job design, work duties and employees' skills, which will shift and evolved for something more suitable for using technologies (Kagermann et al., 2013). Moreover, communication/integration between workers of the same/different departments will increase (Kagermann et al., 2013).

The division of labor, training and skills of employee will be changed due to Industry 4.0 and these changes will affect human resources department directly. The tasks required from each job will become more suitable for use of technology, employees will become more empowered with these new skill-sets. The employees will become more involved in comprehensive decision making, coordinating/managing their own jobs (Kagermann et al., 2013; Schuh et al., 2014; Stock & Seliger, 2016). Moreover, career planning will need to become more flexible (Kagermann, 2015; Kagermann et al., 2013) and interdisciplinary (Kagermann, 2015; Stock & Seliger, 2016). Moreover, the hiring procedure of employees in HRM will also change as the number of workforce goes down (Stock & Seliger, 2016) and the demand for high skilled employees goes up (Kagermann et al., 2013; Rüßmann et al., 2015; Schuh et al., 2014). Demand for skilled workers' in mechanical and engineering sectors will increase (Kagermann, 2015). Thus, the human resources department will have to adapt to changes and focus on hiring workers who have the necessary skills to keep up with Industry 4.0 changes (software and information technology) (Rüßmann et al., 2015).

6.2.2.1 Motivation and Aim of the Study

With the wide popularization of the topic- within not only Turkey but also a global context-policymakers, managers and researchers alike have started questioning the potential benefits of transitioning towards Industry 4.0. Coupled with the overall importance of the manufacturing industry and its contribution towards country growth, the Turkish Government launched a project-based incentive system in order to accelerate the shift towards Industry 4.0 under manufacturing firms. This creates a motivation to analyze the current Industry 4.0 application levels and firms implementation activities of the initiative. Industry 4.0 is a new development that most countries (including the EU member states) are struggling with, or are planning to implement in the coming years. Moreover, as technological advances strongly dictates industrial productivity, in order to (1) ensure that firms adapt to the oncoming changes, (2) become more efficient and transparent; researchers, policy makers and managers alike are motivated to get ahead and focus on the new field of study. Thus, it is hoped that this chapter will aid in providing these interest groups with an in-depth look that will aid countries who are currently planning to go through with the switch.

Aiming to serve as a road map for countries wishing to improve their current Industry 4.0 planning by addressing the activities of transitioning firms, this chapter will detail the current practical application of Industry 4.0 under manufacturing firms. Overall, the study aims to clearly identify alternatives between Industry 4.0 activities and benefits. Considering the high cost associated with the digitalization movement, this is imperative for moving the Industry 4.0 debate forward.

In order to determine the firms' recognized/actualized benefit outcomes from transitioning towards Industry 4.0, a content analysis was conducted on the 2017 annual activity reports of manufacturing firms listed on the BIST. Following the steps outlined by Tranfield, Denyer, and Smart (2003) we attempt to map and assess "available evidence" to provide "insights and guidance" for analyzing our research question, which is "What are the actualized Industry 4.0 benefits identified by transitioning listed manufacturing firms?". By conducting this analysis, the chapter aims to create an understanding of the usage and effect of the Industry 4.0 transition overtaking the business world.

Turkey's developing country status also provides the international literature with a unique perspective, as most countries that are close to completing their Industry 4.0 transition are currently "developed countries" with large budgets. To the best of our knowledge there is no such study in practice and the chapter is novel.

6.2.3 Sample Selection

6.2.3.1 Industry Selection

Despite the fact that all sectors and business functions/departments will ultimately benefit from the digitalization movement, the manufacturing industry is currently at the focus of the Industry 4.0. Promising to gain from the various technological advances, this industry is described as the "the main engine" responsible for transforming demand into "growth" (Kaldor, 1957). Examining the relationship between national industrial development and economic growth, the author argues that there is a strong positive correlation between GDP and industrial activity. Thus, Industry 4.0 development is (1) expected to largely target industrial production (Strandhagen et al., 2017), and (2) emerging technologies can have an impact on manufacturing approaches/businesses (Zhong et al., 2017). This is motivation for including manufacturing firms under the sample. Upon selection of the sample, information regarding the sector classifications were downloaded from the KAP (the Turkish Public Oversight Platform). The sample was categorized under the nine sub-sector groupings of KAP.

6.2.3.2 Source Document Selection

In order to determine the Industry 4.0 transition status of the sample, the annual activity reports were employed. The annual reports were selected as the source document for the following reasons; (1) according to the Turkish Commercial Code the annual report must be audited. The information presented under the entirety of the report must be prepared without including misleading, extraordinary and untrue statements and must fairly reflect the company's financial performance over a given period (TTC: 397). Thus, this had the benefit of increasing the reliability of the information provided under the source document. Moreover, (2) the publication of the annual reports are compulsory and allow for comparability.

All BIST listed firms are required to publish their annual activity reports alongside their financial statements and are made available on the official website of the organization. Thus, the existence of these comparable reports for each firm provide researchers with the unique opportunity of possessing data on the current and future ongoing of the organization. Thus, another reason for employing use of these annual activity reports are because (3) the reports are easily accessible under the investor relations section of the official firm website. Finally, the most important reason for employing these annual reports are the fact that (4) they are considered as a modern advertisement/communication tool (Stanton & Stanton, 2002). These reports serve towards conveying detailed information regarding the current Industry 4.0 activities of the firm.

6.2.3.3 Country Selection

In light of the growing awareness for Industry 4.0, national governments have started adopting large-scale policies to increase productivity and competitiveness of their industries (EU Commission, 2017a). However, with only 28% of current EU Members implementing these changes, Turkey (as a developing, non-EU country), provides a rewarding setting for analyzing firms current Industry 4.0 application and implementation activities. Coupled with the fact that each country differs in regards to their target audience, budget amount, funding approaches, policy designs and implementation strategies- it is hoped that the "Project Based Incentive System" outlined in Turkey will hold particular importance for researchers and countries aiming to transition towards Industry 4.0. Coming from the perspective of a developing and candidate country, the information gained on Industry 4.0 applications in Turkey could contribute towards a better understanding within the international literature. The data collected from the study could, ultimately, be generalizable across different countries. Moreover, the fact that Turkey has taken the necessary steps in order to incorporate Industry 4.0 under its manufacturing industry, well before several EU member states, highlights the importance of this country analysis.

6.2.3.4 Sample Year

The annual reports prepared for 2017 was selected for the content analysis as it corresponds with the launch of the "Project Based Incentive System" which aims to aid manufacturing firms in transitioning towards Industry 4.0. Following the trend set by the German Federal Government (EU Commission, 2017b) the incentive system was launched by the Turkish Government in order to increase technological development, national competitive advantage and reduce the trade deficit. The initial announcement in 2017 resulted in a large number of firms willing to restructure their manufacturing processes and submitted project proposals (Sanayi Gazetesi, 2018) in preparation toward the 135 billion Turkish Lira incentive. Thus, the 2017 annual reports are only included in the sample as they are argued to reflect the current Industry 4.0 activities under Turkish firms.

6.2.3.5 Listed Firms

Only firms listed on the Istanbul Stock Exchange (BIST) was included in the sample. The reason for this is the fact that firms that are listed on the exchange need to mandatorily prepare and maintain financial reports. Thus, the information employed for evaluating the sample is consistently available. Moreover, listed firms are argued to disclose more information than non-listed firms. Not only are these firms striving towards fulfilling the minimum disclosure requirements, they are also more likely to provide quality voluntarily information. One reason cited for this under the disclosure literature is firm motivation to increase investor confidence (Raffournier, 1995). As a result, it was concluded that the listed firms on the exchange would be willing to provide more detailed information than non-listed firms in order to further communicate their intentions or activities with investors. Thus, these firms are more suitable for analyzing currently ongoing investments within firms.

6.2.4 Employed Qualitative Method

The full-text of the 2017 annual activity reports for the manufacturing firms listed under the Istanbul Stock Exchange were analyzed in order to retrieve information relating to firm Industry 4.0 activities. The source documents were downloaded from the investor relations section under the official website of each firm.

Under the next step of the analysis the source documents were searched via use of several keywords. This stage of the study was conducted by two researchers in order to ensure annual report addressing "Industry 4.0" was not left out of the analysis.

Table 6.2 Transitioning firms identified under the manufacturing industry

Industry	Count	Percentage
Textile, wearing apparel and leather	1	5
Food, beverage and tobacco	3	15
Chemicals, petroleum rubber and plastic products	5	25
Fabricated metal products, machinery and equipment	8	4
Wood products and furniture	1	5
Non-metallic mineral products	2	10
Total	20	100

Any activity pertaining to Industry 4.0 was determined by use of critical keywords, such as; "digitalization", "4.0", "Industry 4.0" and "smart factory". After individually searching through the 178 documents, the identified firms were re-evaluated by the second researcher and text concerning the transition towards Industry 4.0 were recorded under an Excel sheet. Out of the 178 listed manufacturing firms under BIST, only 20 were identified as transitioning towards Industry 4.0. Table 6.2 provides the sub-sector distribution of the identified Industry 4.0 transitioning firms.

The highest percentage of firms transitioning towards Industry 4.0 within the year 2017 are firms operating within the "Chemicals, Petroleum Rubber and Plastic Products" sector at 25%. While the second and third highest sectors are the "Food, Beverage and Tobacco" (15%) and "Non-Metallic Mineral Products" (10%), respectively.

Following the identification of firm activities relating to Industry 4.0, the recorded text was subject to an inductive analysis and the categories/themes were drawn from the data (Strauss & Corbin, 1990). This stage of the analysis was conducted in the presence of all three researchers and the text was separated into actualized firms benefits from Industry 4.0 depending on the business function affected. Out of 20 of the listed manufacturing firms under BIST identified as transitioning towards Industry 4.0, only 16 made mention of a benefit from the switch. At this stage of the study, the sample was reduced from 20 firms to 16 firms.

For the second stage of the analysis, the identified benefits were further separated into groups according to underlying categories/themes. These categories were determined employing use of the guiding principles presented under Tranfield et al. (2003). Under this stage, the researchers attempted to map and assess "available evidence" according to their business functions and themes. These business functions were determined with the aid of Brown (2008: 17–18).

As mentioned above, this portion of the analysis was conducted with all researchers present. Each individual theme/category was discussed in detail along with the identified benefits up for coding. Any ambiguous item was resolved with the vote of the third researcher. The final set of benefits coded reflect the joint review of all authors.

Table 6.3 Firms and dispersion of the items referring benefits of Industry 4.0

	Firms	Number of items	%
1	Vestel Beyaz Eşya ve Elektronik Sanayi ve Ticaret A.Ş.	70	30.17
2	Anadolu Isuzu Otomotiv Sanayi ve Ticaret A.Ş.	40	17.24
3	Türk Traktör ve Ziraat Makineleri A.Ş.	40	17.24
4	Tüpraş-Türkiye Petrol Rafinerileri A.Ş.	28	12.07
5	Petkim Petrokimya Holding A.Ş.	16	6.9
6	Kordsa Teknik Tekstil A.Ş.	6	2.59
7	Soda Sanayii A.Ş.	6	2.59
8	Pınar Su Sanayi ve Ticaret A.Ş.	5	2.16
9	Anadolu Cam Sanayii A.Ş.	4	1.72
10	Tat Gıda Sanayi A.Ş.	4	1.72
11	Ford Otomotiv Sanayi A.Ş.	3	1.29
12	Arçelik A.Ş.	2	0.86
13	Aygaz A.Ş.	2	0.86
14	Ditaş Doğan Yedek Parça İmalat ve Teknik A.Ş.	2	0.86
15	Otokar Otomotiv ve Savunma Sanayi A.Ş.	2	0.86
16	Pınar Süt Mamülleri Sanayii A.Ş.	2	0.86
	Total	232	100

6.3 Findings

As mentioned above, each firm was individually analyzed and the Industry 4.0 actualized benefits/outcomes were coded under excel. This initial analysis yielded a total of 232 items from the 16 sample firms. The distribution of the identified items and their percentages are presented below under Table 6.3 along with the firms. The top 5 ranking firms (Vestel, Anadolu Isuzu, Türk Traktör, Tüpraş, Petkim) in the analysis constitute approximately 84% of actualized benefit items. The firms item dispersion is provided below under Table 6.3.

As mentioned before, the information collected from the annual activity reports were grouped under six main business functions categories via use of the Brown (2008: 17–18) study. These categories are as follows: operations, strategic management (Cost and Competitive Advantage), human resources, marketing, procurement and distribution, and technology and process development. These six categories were used as the coding and analytical framework of the study.

While the operations function, with 41%, dominates the actualized benefits recognized by firms from transitioning towards Industry 4.0, the results of the level 1 analysis offers supportive evidence that other departments are also affected by the integration. The unit of analysis was items referring a benefit brought by the Industry 4.0 applications and mentioned in the annual activity reports of the firms. In the reports, there were 95 (41%) items related to operations function, 51 (22%) items related to strategic management (Cost and Competitive Advantage) function, 36 (15%) items related to technology and process development function, 27 (12%) items related to procurement and distribution function, 19 (8%) items related to

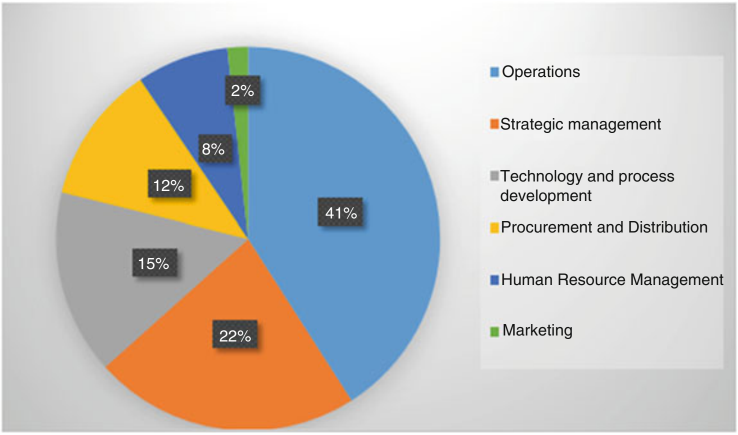

Fig. 6.1 Dispersion of business function categories benefited from Industry 4.0

human resources management function, only 4 (2%) items related to marketing function. The percentage distribution of the total items according to business function categories (theme 1) are shown in Fig. 6.1.

Following the level 1 analysis, the extracted data (sentences) from the annual reports were subjected to a second content analysis and separated into themes. These themes (level 2 and level 3) consisted of the expressions referring to actualized benefit brought by Industry 4.0 applications and the sub-categories for each business function activity. The processes or activities were coded simultaneously and at the discussions of the three researchers. The business functions, their sub-categories, benefits and frequency of items referring the common actual benefits are provided under Table 6.4.

6.3.1 Strategic Management (Cost and Competitive Advantage)

Items related to strategic management function were categorized into four sub-categories: gaining differentiation advantage, gaining cost advantage, corporate strategy development, and coordinating activities. The number of items under the first sub-category, gaining differentiation advantage, is 18 and it accounts for 7% of all items. Under this category, we see that firms take part in Industry 4.0 activities; such as, transferring into open innovation processes and increasing/accelerating innovation with smart manufacturing systems. As previous researchers confirmed, usage of smart systems within the business increases the speed of innovation with increasing value creation and evolving business models (Jazdi, 2014; Kagermann et al., 2013; Rüßmann et al., 2015; Schuh et al., 2014). Moreover, firms have attempted to strengthen their position in the market and achieve sustained

Table 6.4 Business functions addressed in items referring benefits of Industry 4.0

Business functions (Theme 1)	Sub-categories (Theme 2)	Benefits (Theme 3)	Frequency of items
Operations	Developing operation process	Integration of robotic-based systems into manufacturing	6
		Reaching efficient production	6
		Business process improvement	4
		Improving production line efficiency	4
		Improving productivity	3
		Achieving in-house communication	2
		Conducting production optimization	2
		Production capacity improvement	2
		Optimizing order procurements	1
	Quality, control and assurance	Conducting continuous assessment and improvement	11
		Improving production monitoring	8
		Developing remote control systems	5
		Development of feedback systems	2
	Managing production	Enhancing error detection	10
		Conducting digitized problem solving	5
		Improving maintenance activities	4
		Effective production planning	1
	Producing goods	Improving production efficiency	15
		Improving productivity	4
Strategic management (cost and competitive advantage)	Gaining differentiation advantage	Enhancing innovation activities	4
		Gaining competitive advantage	4
		Improving technological infrastructure	3
		Reaching alternative markets	3
		Following trends	2
		Improving trade performance	1
		Improving workforce competence	1

(continued)

Table 6.4 (continued)

Business functions (Theme 1)	Sub-categories (Theme 2)	Benefits (Theme 3)	Frequency of items
	Gaining cost advantage	Achieving investment efficiency	5
		Improving production efficiency	4
		Achieving energy efficiency	3
		Improving logistic activities	2
		Improving maintenance activities	1
		Improving inventory management	1
	Corporate strategy development	Achieving sustainable growth	3
		Improving profitability	2
		Improving stakeholder relations	2
		Developing business models	1
		Developing corporate culture	1
	Coordinating activities	Achieving cross-department harmony	4
		Reaching operational excellence	4
Technology and process development	Collecting and processing data	Conducting data analysis	5
		Conducting data collection	4
		Conducting data reporting	2
	Product or service designing	Achieving rapid prototyping	4
		Conducting digital designing	2
		Conducting individualized production	2
	Developing software	Developing remote control systems	2
		Development of robotic-based systems	2
		Conducting maintenance	1
		Conducting safety management	1
	Cyber security improvements	Enhancing data protection	2
		Enhancing network protection	2
		Enhancing protection standards	2
	Developing process	Incorporating technological adaptation	3
		Improving technological infrastructure	2

(continued)

Table 6.4 (continued)

Business functions (Theme 1)	Sub-categories (Theme 2)	Benefits (Theme 3)	Frequency of items
Procurement and distribution	Distribution	Integration of robotic-based systems into logistics	7
		Achieving logistics efficiency	5
		Achieving in-house communication	1
		Conducting safety management	1
		Optimization of logistics activities	1
	Procurement	Improving inventory management	7
		Achieving inventory optimization	2
		Developing remote control systems	2
		Achieving in-house communication	1
Human resource management	Managing working conditions	Conducting safety management	6
		Improving workforce efficiency	3
		Improving workplace productivity	1
	Training	Improving training quality	3
		Achieving technical competence	2
	Managing human resources	Improving workforce efficiency	3
		Conducting digital planning	1
Marketing	Providing customer relations	Achieving customer involvement	1
		Improving service quality	1
		Increasing customer satisfaction	1
	Managing corporate image	Improving corporate trustworthiness	1
Grand Total			232

competitive advantage among rival companies. One method of achieving this has been through increasing the technological advantage of the firm and making sure they are protected against disruptive technology by introducing a digital strategy.

While transitioning, firms have also attempted to reach alternative markets and have argued that Industry 4.0 integration protected them from the competitive power of the global market. One technological advantage has also been the adaption to the fast-moving world and following of production trends, increased productivity of the trade cycle and differentiated-qualified human resources. In terms of gaining a cost advantage, firms have achieved investment, production, energy efficiency; improved logistic, maintenance activity and inventory management. By use of this technology, firms have been able to analyze project costs, realized all projects with low costs (with the help of simulation analysis), decreased internal losses and manufacturing costs (with collaborative robotics), increased operational energy-saving, decreased lighting/heating costs, decreased transportation/logistics costs (with the help of factory stores that communicates with each other), decreased the cost of machinery breakdown maintenance and decreased inventory costs. These findings are in line with the literature that supports the cost reduction effect of Industry 4.0 (Lee, 2008; Varghese & Tandur, 2014).

The third sub-category is corporate strategy development and contains five benefits: achieving sustainable growth, improving profitability, improving stakeholder relations, developing business models, and developing corporate culture. Under their Industry 4.0 activities firms have maintained the firm's durability and sustainable growth, improved profitability, improved stakeholder relations by communicating the automation process with stakeholders. Moreover, they have enriched all stakeholders with new applications, created new productive business models and added value to the corporate culture. Thus the systems and the communicated information brought by Industry 4.0 will allow managers to allocate and use resources more efficiently (Jazdi, 2014), make decisions faster and supported (Kagermann et al., 2013) since each function/activity within the business will be better coordinated (Kagermann et al., 2013).

The last sub-category of strategic management (Cost and Competitive Advantage) function is coordinating activities which contains two actualized benefits: achieving cross-department harmony and reaching operational excellence. Concerning these activities, firms have integrated the marketing and production stages, planed sales according to manufacturing information collected from Industry 4.0 programs, and finally, achieved collaboration between the research & development and manufacturing departments. Ensuring that product development is conducted in a much more efficient manner.

6.3.2 Operations

Items referring to the benefits of the operational function were further categorized (theme 2) into four sub-categories: developing operation process, quality control and assurance, managing production, and producing goods. The number of items that fall under developing operation process sub-category is 30 accounting for 13% of the total. This sub-category contains nine Industry 4.0 actualized benefits for firms, as listed under Table 6.4. Each theme and the activities leading to the actualization of these benefits are recognized below.

In order to achieve" integration of robotic-based systems into manufacturing" firms have had to automate their production processes and develop unmanned/fully automatic machines. This was conducted in order to reduce the manpower required for production and to reduce the number of errors in manufacturing. As stated under the literature by Varghese and Tandur (2014) the quality of production increases as repairs and defects decrease. Although this item is one of the most popularized benefits of Industry 4.0 under the literature, it is only mentioned 6 times out of the 232 actualized benefits. This could be a result of the high-costs associated with the integration of these fully automated robotic systems for manufacturing firms. The second highest actualized benefit under the Developing Operation Process activities is "reaching efficient production". By increasing competence in the manufacturing process, increasing the speed of production and working on time-efficiency via information generated from the installed digitalization programs; firms have actualized this benefit under their operations. Moreover, we see that firms have made innovative changes in business management by simplifying the operational processes and organizing a dynamic/continuous production plan with the help of Industry 4.0 applications (improve business processes). To "improve productivity" firms have accelerated and shortened the production and manufacturing processes and to "improve the production line efficiency" they have increased their flexibility regarding production of goods. According to the information collected from the firms' annual activity reports, this has optimized the production processes of the sample firms.

During their Industry 4.0 transition, firms have also attempted to increase communication and integration between machines and the production department (achieving in-house communication). The data generated from this in-house communication ensures that each department is aware of the number of goods being produced or the level of raw material on hand. This allows for firms to efficiently plan the production of new orders and cut back on storage costs. Finally, firms have optimized demand/supplier order processes and increased production capacity while transitioning towards Industry 4.0. However, these constitute as a relatively small proportion (16%) of items under this sub-category.

The second operational function activity analyzed is "quality, control and assurance". The number of items mentioning benefits under this sub-category is 26 and accounts for 11% of the total. This sub-category contains four benefits: conducting continuous assessment and improvement, improving production monitoring, developing remote control systems, development of feedback systems, respectively. Under this category firms have enhanced production quality via use of augmented and virtual reality programs, standardized process quality (and also improved the visibility, speed, productivity and understandability of processes), detected errors and changes in the system with the help of Industry 4.0 programs (continuous assessment and improvement). Firms have also taken steps to increase monitoring on the production floor (improving production monitoring) and remotely followed performance by means of robotics (developing remote control systems). Finally, firms have developed online feedback systems in manufacturing and subsequently increased the production quality. This is in line with what is supported under the literature. Industry 4.0 improvements enable production systems to be controlled remotely so that these systems will become more flexible and employees can make last minute configuration and produce more individualized products (Kagermann et al., 2013).

The third sub-category under the operations function is managing production activity with 21 items (9% of total). While transitioning under Industry 4.0 firms have taken proactive actions in order to intervene in malfunctionings, unplanned halts of production via use of 3-D prototyping and conducted multiple test to detect errors. Moreover, they have reduced the level of risk under production within the assembly line (enhancing error detection). The in-house communication implemented under operations has also contribution towards decreasing errors and increased instant decision-making. Maintenance activity were increased and conducted before machine breakdowns, ensuring timely production planning.

The final subcategory under operations is the production of goods. This category houses 19 items and makes up 8% of the total identified benefits. By incorporating industry 4.0 activities, firms have been able to improve production efficiency and productivity by integrating online feedback system, automatic leading and collaborative robot technology under operations. As mentioned in previous researches and as identified under our analysis (with 41% items from the total) production is the most affected area from Industry 4.0. Thus, it is not surprising that Industry 4.0 transitioning firms have enhanced their productivity through increased speed through performance engineering (Ganzarain & Errasti, 2016; Kagermann, 2015; Rüßmann et al., 2015).

6.3.3 Technology and Process Development

Technology and process development function has the highest number of subcategories when compared to other business functions in the study. Items related to this function were categorized into five sub-categories, including 15 benefits. The first sub-category collecting and processing data contains three benefits: conducting data analysis, conducting data collection, and conducting data reporting. By integrating the Industry 4.0 activities under their operations, the sample firms have become technologically capable of advanced analytical analysis that allows them to monitor information through cloud computing. It has now become possible for these firms to obtain data about benchmarks, machine production and factory production through monitoring equipment. As mentioned before in the literature, “cyber-physical systems and internet of things” technologies brought by Industry 4.0 enable all devices and systems automatically collect, analyze and interpret data (Blanchet et al., 2014). The information generated from the technology allows for machines to communicate with each other, collect inputs through production and use this information to prepare production reports digitally.

The second sub-category product/service designing contains three benefits: achieving rapid prototyping, conducting digital designing, and conducting individualized production. Through these, firms have been able to conduct complex product testing via use of 3-D printers. These printers have allowed organizations to obtain their technological goals in a progressive, faultless and quick manner. This results from 3-dimensional virtual objects giving change to observe changes immediately without any need to manufacture prototype beforehand (Fiorentino et al., 2002; Paelke, 2014). Firms have also employed use of special simulations and virtual-reality programs to realize their projects. The flexibility afforded through industry 4.0 integration has increased the manufacturing of custom-made products per customer demand.

The third sub-category developing software contains four benefits: developing remote control systems, development of robotic-based systems, conducting maintenance, and conducting safety management. These activities have allowed for firms to manage all machinery, regardless of the location of factory and control automatic processing simultaneously. Manufacturing has progress to robotics/systems without human intervention. Moreover, collaborative robots that contains the ability to work with operators have been integrated into manufacturing. Finally, predictive maintenance and hot spots that permit workplace safety management have been integrated into operations.

The fourth sub-category cyber-security improvements contains three benefits: enhancing data protection, enhancing network protection, and enhancing protection standards. This has allowed for the protection of the company and corporate data from cyber-attacks (internal or external threats). Intranets/network security and technological infrastructure have been increased while maintaining cyber-security standards. This is in line with the literature as cyber-security and data protection are seen as a core requirements of implementation of Industry 4.0 since data protection enables effective integration of production systems/networks throughout the business entity (Kagermann et al., 2013; Rüßmann et al., 2015).

The fifth sub-category developing process contains two benefits: incorporating technological adaptation and improving technological infrastructure. These technological advancements have been adapted to not only the operations departments but all functions of the business; from sending the order to the supplier to shipping the final product to the customer.

6.3.4 Procurement and Distribution

The procurement and distribution function has two sub-categories including nine benefits referring to 27 items (12%). The first sub-category distribution involves five benefits: integration of robotic-based systems into logistics, achieving logistics efficiency, achieving in-house communication, conducting safety management, and optimization of logistics activities. As mentioned previously under the operations function, procurement and distribution too has incorporated advanced robotic based systems into their daily business activities. These activities consist of improving logistic operations by realizing “remote control in-factory” transfers and storing activities via robotics and utilizing unmanned transportation vehicles in materials' transfers. This has increased in-house store communication and in turn, boosted the efficiency and productivity of logistic operations, while increasing the monitorability of outputs. Moreover, these integrated systems have also allowed for conducting better safety management by enabling in-factory transportation in a safer/planned manner.

The second sub-category procurement contains four benefits: improving inventory management, achieving inventory optimization, developing remote control systems, and achieving in-house communication. By managing and controlling inventories online, firms have been able to create system orders automatically when their inventories shorten and have subsequently been able to cut back on inventory cost (via in-house factory communication). This has resulted in increased order speeds (improving inventory management) and optimized inventory management (via virtual reality training). Finally, the Industry 4.0 systems have made the monitoring of raw materials easier in the digital environment and this has allowed for automatic briefings to be generated on inventory ratios.

6.3.5 Human Resource Management

Human resource management function accounts for 8% of all items. By integrating Industry 4.0 under this business function, firms have been able to "conduct safety management" via increasing work safety standards with digital mapping. Moreover, firms have been able to increase job security in production and employee use of robots (instead of human workers) in risky situations. In order to improve "workforce efficiency" and "workplace productivity" they have started practicing ergonomic manufacturing and integrated Industry 4.0 applications in the back-office. The integration has also improved training quality and worker technical competence. This is because industry 4.0 facilitates employee empowerment which enables them involve in comprehensive decision making processes and coordinate/manage their own jobs (Kagermann et al., 2013; Schuh et al., 2014; Stock & Seliger, 2016). Moreover, skills (technical and inventory management) have been improved via use of virtual reality and augmented reality training operators, while workloads have been reduced with digital conversion projects and digital personnel planning.

6.3.6 Marketing

The final business function which has the least number of referred benefits of Industry 4.0 is marketing (4). The marketing function has two sub-categories including four benefits accounting for only 1.7% of all items. Firms addressing these actualized benefits under their operations have argued that, via transitioning towards Industry 4.0, they have been able to collect more feedback from their customers and improve service quality/customer satisfaction as a result. This finding is also in line with the literature. When comprehensive and continuous information about consumers becomes accessible, the segmentation and targeting activities are managed more effectively by marketing professionals (Kagermann, 2015). Finally, one firm has argued that Industry 4.0 has improved their corporate trustworthiness.

6.4 Conclusion

The objective of this study was to conduct a content analysis on annual activity reports of manufacturing firms listed on BIST to reveal perceived benefits brought by Industry 4.0 applications. Based on the analysis of activity reports published by 16 firms, this study has presented the dispersion of 232 item grouping under six main business functions, their subcategories and actualized/realized benefits. The findings extracted from 20 different sub-categories and 74 detailed listed benefit under sub-categories show that the manufacturing firms benefit from Industry 4.0 are the operations, strategic management (Cost and Competitive Advantage), technology and process development, human resources management and marketing functions, respectively.

The analysis revealed that the sub-categories for each business function are as follows. Under the operations functions, the identified sub-categories are as; the developing operation process, quality, control and assurance, managing production and producing goods. This business function is one of the most affected function from the implementation of Industry 4.0. The second most affected business function is strategic management (Cost and Competitive Advantage), which includes the following subcategories; gaining differentiation advantage, gaining cost advantage, corporate strategy development and coordinating activities. After the strategic management (Cost and Competitive Advantage) function, technology and process development is the third ranking function. The sub-categories are collecting and processing data, products or service designing, developing software, cyber-security improvements and developing process. The remaining identified business functions contain procurement and distribution, human resource management (managing working conditions, training and managing human resources) and marketing (providing customer relations, managing corporate image).

A limitation of this study is the current lack of transitioning Industry 4.0 firms under the Turkish manufacturing sector. Even though the growing importance of Industry 4.0 as been recognized by national governments and agencies, the transition towards this revolution is still ongoing. Thus, at this stage of implementation, the level of information available is lacking. As a future recommendation, the sample restrictions could be expanded to include non-listed firms operating in sectors other than manufacturing.

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Chapter 7
A New Marketing Trend in the Digital Age: Social Media Marketing

Selay Ilgaz Sümer

Abstract Technology plays an important role in the lives of businesses. For this reason, today, it is not possible for a company to maintain its existence without using technology. In the digital age, along with increasing technology usage, the distance between businesses and consumers has disappeared. In other words, technology serves as a bridge between these two parties. With such technology usage in the activities of businesses, the companies have tried to reach their target markets by using their websites. However, today, they have also started to use social media networks as a way to attract their customers' attention to their products and, thus, communicate with them more easily. In social media, it is not just the businesses that promote products and services. Consumers can influence each other's preferences through comments that they share over social media. Their comments on social media are important in the promotion of goods and services. Therefore, it would not be wrong to say that social media is an effective marketing tool in today's business environment. This chapter is aimed at examining the concept of social media marketing and its effects on the marketing activities of businesses.

7.1 Introduction

Contemporarily, technology has an important place in the lives of businesses. For this reason, firms that can keep up with technology can continue their existence, and others will disappear. Therefore, businesses that are open systems should follow the changes in the external environment and adapt themselves to new technological developments.

One of the most important technological developments affecting the lives of businesses is the internet. By means of the internet, businesses have begun to follow their environment more comfortably and have strengthened their relationships with

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their customers. At this point, the webpages created by businesses play a very important role in such relationships. Through webpages, businesses and consumers can strengthen their communication with each other. In addition, webpages can be used as an effective tool for firms to communicate information about their goods and services to their target markets. Customers who visit the website of the company will be able to obtain detailed information about the products and request information from the companies at certain points in time.

In addition to the webpages that have been used by businesses since the introduction of the internet, social media has become a common meeting point for firms and consumers. According to the 2018 reports of "We Are Social", there are 4.021 billion internet users, 3.196 billion active social media users, 5.135 billion mobile phone users and 2.958 billion active mobile social media users in the world (https://wearesocial.com/us/blog/2018/01/global-digital-report-2018). The data show that there is a mass of people in the world that are willing to use the internet and social media. The increase in the number of smart phones that consumers have also has an important impact on social media usage. At this point, businesses have tried to turn the current situation into an advantage, and it is common for them to use social media as a bridge in their relations with customers. Thus, in marketing, a new trend, called social media marketing, has emerged.

Social media marketing can be considered one of the most important aspects of the marketing activities of the digital age. Social media can be considered a new marketing tool for both small and large businesses. By means of the marketing activities carried out through social media, businesses have been able to reach a wide audience. Businesses can do this at a low cost. Consumers have the opportunity to find and access detailed information about the products produced by businesses. Consumers also have the opportunity to make comments about goods and services through social media. Social media, which is used extensively by businesses, helps them market products while also contributing to the development of customer relationships. It would not be wrong to say that one of the main reasons why social media marketing is effective is related to two-way communication between the businesses and their customers.

In this chapter, social media marketing, which plays a very important role in the marketing activities of businesses, will be examined. In this context, the social media concept, the development of social media, social media tools, comparison of social media with traditional media, and the features of social media will be emphasized. Afterwards, social media marketing, characteristics of social media marketing, advantages and disadvantages of social media marketing, social media marketing process, consumer behaviour in social media, emerging social media marketing activities in the digital age will be discussed.

7.2 The Concept of Social Media

The emergence of the digital age has led to significant developments in communication between individuals. One of the most important developments in communication is the intense use of social media in the digital age.

In the literature, various definitions of social media have been put forward. According to Kaplan and Haenlein (2010: 61), “social media is a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content.” Greysen, Kind, and Chretien (2010: 1227) explained the concepts as “content created by internet users and hosted by popular sites such as Facebook, Twitter, YouTube and Wikipedia and blogs.” According to Zeng et al. (2010: 13), “social media refers to a conversational, distributed mode of content generation, dissemination and communication among communities.” Neti (2011: 2) defined social media as “communication/publication platforms which are generated and sustained by the interpersonal interaction of individuals through the specific medium or tool.” Howard and Parks (2012: 362) defined the concept of social media in three main parts. According to them, “social media is consisting of (a) the information infrastructure and tools used to produce and distribute content; (b) the content that takes the digital form of personal messages, news, ideas and cultural products; and (c) the people, organizations, and industries that produce and consume digital content.”

When these definitions in the literature are examined, it can be seen that although the concept of social media is defined in different ways, there are some keywords to be used in explaining the related concept. Web 2.0 and user-generated content are among these keywords. The concept of Web 2.0, introduced by O’Reilly Media in 2004, covers second-generation internet-based services. Through Web 2.0, people use a virtual environment to share information with each other and, sometimes, to generate or share content. In the definitions of Web 2.0, the user-generated content that we encounter in the above definitions includes all kinds of content produced by end users that is accessible to everyone in the virtual environment. At this point, Wikis, social networking sites and folksonomies are used by people (Turban, King, Lee, Liang, & Turban, 2012). In Web 2.0, users are people who not only consume content but also become content-producing individuals. By using Web 2.0 applications, it becomes easier to share these thoughts and comments with many people at the same time. In short, Web 2.0, which enables people to communicate with each other simultaneously, has a structure that combines humans and technology in the same pot. Furthermore, through Web 2.0, electronic word of mouth (EWOM) has now started to replace traditional word of mouth. At this point, blogs and social networks are being used as an important tool for internet users to share comments (Akrimi & Khemakhem, 2012). Within this context, Facebook, Flickr, Myspace, and YouTube are among the major social network services used by many people. By using these network services, consumers have the opportunity to share their positive and negative thoughts about goods and services with other consumers, make comments about various issues and share them with people all over the world.

It can be seen that the social media activities that emerged with Web 2.0 have enabled passive consumers to become active, and the relations between the parties have strengthened. For this reason, social media plays an important role for both businesses and consumers, as will be discussed in detail in the following sections.

7.3 The Development of Social Media

In the periods when internet publishing first appeared, there was a one-way flow of messages, just as with other mass media such as televisions, radios, journals, etc. Along with the introduction of Web 2.0, a concept that has been introduced to the literature by O'Reilly Media, the direction of communication has changed. Hereafter, the media and media users have become the centre of communication. Thus, two-way communication has begun to be on the agenda (Aktaş & Ulutaş, 2010).

In fact, the infrastructure of Web 2.0, which plays an important role in bringing social media to the present level, is quite old. When the building blocks of social media are examined, Tom Truscott and Jim Ellis come to mind first. In 1979, Tom Truscott and Jim Ellis, who were graduate students at Duke University, made important contributions to the development of social media. They created Usenet, which enabled people to send and publish social content messages to each other. Afterwards, in 1979/1980, the online role-playing game Multi-User Dungeon emerged, created by Roy Trubshaw and Richard Bartle. In 1989, Bruce Abelson and Susan Abelson founded Open Diary, which enabled online diary writers to gather in a single area. The first website was created in 1991, which can be considered an important turning point for the social media adventure. In 2001, Wikipedia, which is an editable and open encyclopaedia, emerged (Aktaş & Ulutaş, 2010; Kaplan & Haenlein, 2012; Karadeniz & Gözüyukarı, 2015). After all these developments, the social media adventure has continued its journey with the emergence of new social networking sites. In 2003, LinkedIn was launched. LinkedIn is a social network that aims to bring together all professionals in the world. At this point, it would not be wrong to say that LinkedIn is a key to creating and enlarging social capital in particular (Cooper & Naatus, 2014). In 2004, Facebook was launched by Mark Zuckerberg (Bhagwat & Goutam, 2013). According to statistics, as of January 2019, Facebook is the largest social networking site, which exceeds 1 billion registered accounts and has 2.27 billion active users monthly in the world (https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/). In 2005, people were introduced to YouTube. With a large number of visitors, YouTube operates as a social network service that allows users to share their videos with each other (Khan, 2017). In 2007, the YouTube CEO said that the number of active users of YouTube surpassed 1.5 billion; video viewers who did not log into YouTube are not included in this figure. This means that approximately one-third of the world's population are YouTube users (https://www.cnnturk.com/

teknoloji/youtube-kullanici-sayisini-acikladi). In 2006, a free microblogging service, Twitter, was launched. Based on Twitter's 10/26/2018 data, the total number of active Twitter users monthly is 326 million, and the total number of tweets sent per day is 500 million (Çalışkan & Mencik, 2015; Turban et al., 2012; https://www.omnicoreagency.com/twitter-statistics/). Instagram is another famous platform that was launched in 2010. According to the statistics about the profile of Instagram users in the world, in January 2018, it was found that the people who are using Instagram the most are in the age range of 18–24 years old. On the other hand, the age group who preferred Instagram the least was over 65 years old (Çalışkan & Mencik, 2015; https://wearesocial.com/blog/2018/01/global-digital-report-2018).

7.4 The Features of Social Media

Along with the emergence of Web 2.0 and social media on the agenda, there have been some significant changes in the media sector. When social media is compared with traditional media, the gaps of traditional media are closed by social media, which plays a very important role in the digital age. At this point, it would not be wrong to say that social media, based on its features, has important effects on traditional media.

In some of the studies conducted by various authors, it is seen that the basic features of social media are listed with emphasis on certain points. Michael Fruchter noted that social media has five main characteristics. Fruchter called these characteristics the "5Cs of Social Media". According to Fruchter, conversation, community, commenting, collaboration and contributions are the 5Cs of Social Media (Tokatlı, Özbükerci, Günay, & Akıncı Vural, 2017).

With regard to Lietsala and Sirkkunen (2008), the main characteristics of social media can be listed as sharing user-generated contents, enabling the evaluation of such content, creating high social interaction, providing content to other external networks and having profile pages for active members. These authors expressed that the above points are the five major characteristics of social media.

As can be understood, together with the transition from traditional media to social media, a new media order has emerged with its own features. Through social media, individuals who have assumed the role of the receiver in the communication process in previous periods have now become the senders of the messages. In other words, individuals can now produce content on the one hand, while on the other hand, they have access to a variety of media content with little effort. In short, a two-way communication process in social media has emerged. The increase in the number of participants in the communication process and the openness of social media to feedback have further increased the effectiveness of this process. Hereby, the participants who started to take part in the process have become active participants in the communication process, sometimes by making comments on certain issues, by sharing information on any subject, by voting on various issues, etc. (Solmaz & Görkemli, 2012). One of the most important features of social media is its low cost.

Social media allows for internal content creation so that such content can be shared by almost everyone at almost zero cost. This can be seen as one of the most interesting aspects of social media. In traditional media, content is created by business professionals, while in social media; this task is also performed by non-experts. Another feature of social media is that it offers simultaneous information. Information on an event that takes place at any time in any part of the world can be reached in a short time via social media. Through social media, individuals can share their comments about events in a very short period of time (Çalışkan & Mencik, 2015).

When the basic features of social media and the privileges it brings with it are examined, it is seen that the social media has brought a new breadth to mass communication and makes important contributions to the digital age and that almost every consumer has started to play an active role in mass communication.

7.5 Social Media Marketing

Through the development of technology and the transition to the digital age, mass media have diversified. In the digital age, individuals have tried to communicate with each other using social media. After a while, the intensive use of social media among individuals has become influential on the ways in which businesses communicate with their customers. Hereby, businesses have the chance to be able to address the world by using social media. Now, they have begun communicating their messages related to goods and services to their target audiences through social media and social media ads. Along with the use of social media in marketing activities, in the marketing literature, the so-called social media marketing concept has come into existence. It can be seen that social media marketing has been used by many businesses in recent years. Among these businesses, in addition to well-known brands such as McDonald's, Pizza Hut, and Ben & Jerry's, it is also possible to see many small businesses that are using social media as a marketing channel.

In the related literature, it is possible to find various definitions of the concept of social media marketing. Weinberg (2009: 3) defined the concept as "a process that empowers individuals to promote their websites, products, or services through online social channels and to communicate with and tap into a much larger community that may not have been available via traditional advertising channels." According to Neti (2011: 3), "social media marketing is a marketing using online communities, social networks, blog marketing and more." Turban et al. (2012: 336) noted that "social media marketing is a term that describes the use of social media platforms such as networks, online communities, blogs, wikis, or any other online collaborative media for marketing, market research, sales, CRM, and customer service." According to Chaffey and Chadwick (2016: 528), "social media marketing is monitoring and facilitating customer interaction and participation throughout the web to encourage positive engagement with a company and its brands."

In the literature, it is mentioned that social media marketing should be realized within the framework of having various purposes. In this context, while some of the authors express that social media marketing will contribute to the promotional activities of businesses, some of the authors say that social media marketing will contribute to reputation management, brand loyalty and image management (Kara, 2012). In general terms, it can be stated that social media marketing is realized within the framework of creating brand awareness, identifying opinion leaders, spreading certain messages rapidly, increasing return visits to the site and attracting users to the webpage of the businesses (Weinberg, 2009). As a result of the research conducted on the reasons why brands take part in social media platforms, answers such as establishing sincere relationships with consumers, providing promotions, providing informative content about products, sharing different visuals, entertaining, suggesting special offers to consumers and making negative propaganda about competing companies were provided (Gümüş, 2018).

In fact, social media marketing is the easiest way to reach consumers concerning their sincere thoughts about the goods and services of the businesses. This situation sometimes causes social media to create difficulties for companies. The reason for this is that positive comments can be made by consumers regarding goods and services, and vice versa. As a result of previous research, it was found that 14% of internet users believe and trust the advertisements in traditional media, while 78% of internet users consider the comments made by other users in the virtual environment (Kara, 2012). These results provide important clues about how important it is for the social media platform to be controlled and properly managed by businesses. As a result of another study conducted by Madni (2014), it was found that 53% of consumers considered the forums, social media accounts, company's website and peer reviews of the product before buying a good or service over the internet.

Today, it is known that social media marketing has a feature that enriches traditional marketing activities. Therefore, using social media in a controlled manner and supporting traditional promotional activities by using social media are important for the success of the marketing activities of modern businesses.

7.6 Characteristics of Social Media Marketing

Social media marketing, one of the brightest marketing activities in recent years, differs from traditional marketing in various aspects. In fact, the following features make social media marketing attractive for businesses.

One of the main features that distinguish social media marketing from traditional marketing activities is the fact that the points they focus on are different. In social media marketing, the focus is on people rather than products, and the advertiser of goods and services is mainly the consumer. Therefore, it is necessary to acknowledge that the party that the business should focus on is actually the people. Consumers will be able to significantly influence the purchasing decisions of other consumers through their comments on goods and services in a social media environment. For this reason, the comments made by consumers in the social media environment may cause the business to shine or be discredited in the eyes of some consumers (Chaudhry, 2014). In a study conducted in 2013, it was found that 54% of the participants who had negative experiences transferred these negativities to the people around them fivefold (https://www.marketingcharts.com/digital-28628).

Social media marketing enables businesses to establish two-way communication with both their current and potential customers. This feature, which is unique to social media marketing, enables marketing managers to address the positive and negative criticism made by consumers about their businesses in a fast way. However, collecting feedback from customers in traditional marketing activities is more time-consuming and costly (Hudson, Huang, Roth, & Madden, 2016).

Social media marketing requires the use of various social networking services such as Twitter and Facebook. Businesses will be able to strengthen their relations with customers by using these platforms. In short, social media marketing provides different content to customer relationship management (CRM), thus increasing business-customer interactions (Kara, 2012).

Social media marketing enables consumers to reach the products they think will meet their demands and needs in a short period of time. Through social network services, the information shared by consumers about the products will enable other consumers in the virtual environment to be aware of these products as well (Can & Serhateri, 2016).

Social media marketing allows for word-of-mouth marketing to be realized in a more modernized way. Many businesses offer different alternatives such as discounts to consumers if they like their Facebook pages. It is possible to evaluate this as a in which to generate positive word of mouth (Toksarı, Mürütsoy, & Bayraktar, 2014).

A significant change has occurred in the role of the businesses in social media marketing. Businesses that are trying to present themselves to their target audiences using traditional marketing have now started to strive to understand consumers (Narcı, 2017).

Marketing in social media has changed the subject of marketing activities. More precisely, the subject of "I" has been replaced by the subject of "we" (Narcı, 2017). In other words, the consumers who came together in a virtual environment created a unity among themselves by supporting each other with the content they generated and the comments they made, and they became a large family by adding businesses to this unity.

The marketing activities carried out in social media are aimed at increasing consumer awareness of products through user-generated content (Narcı, 2017). Rather than directing consumers to buy a product, by using social media as a tool, businesses first draw attention to the product. At this point, users rather than businesses have the important tasks. The correct operation of the business will ensure that the user-generated content will be positive.

Social media marketing ensures that brands and the goods or services offered by businesses become known within a shorter period of time (Neti, 2011). When we think that today's consumers consider taking part in social media an important part of their lives, it would not be wrong to say that social media marketing is quite effective compared to traditional marketing efforts.

Through social media marketing, it is possible to apply various methods to inform consumers about businesses. At this point, it would be appropriate to talk about the social media accounts of businesses and their banner advertisements on social media (Şahin, Çağlıyan, & Başer, 2017).

One of the major purposes of social media marketing is to establish a relationship. Accordingly, sales can be considered a benefit of established relationships. Thus, social media marketing differs from traditional marketing in terms of its purpose (Eren Erdoğmuş & Çiçek, 2012).

According to statistics, as of January 2018, it was found that marketing decisions makers use the following major social media platforms: Facebook (94%), Instagram (66%), Twitter (62%), LinkedIn (56%), YouTube (50%), Pinterest (27%) and Snapchat (8%) (https://www.statista.com/statistics/259379/social-media-platforms-used-by-marketers-worldwide/). These statistics show that social media is used intensively by marketers who use various platforms. These findings have promising expectations for the future of social media marketing, which incorporates many important features.

7.7 Advantages and Disadvantages of Social Media Marketing

As a new trend of the digital age, many factors are effective in the use of social media marketing by various businesses. To better understand social media marketing, it is necessary to consider the major advantages and disadvantages separately and plan and control marketing activities on social media platforms.

The advantages of social media marketing have led to this new marketing channel being preferred in recent years. The most important advantage of social media marketing is its low cost. Compared to traditional marketing activities, advertising and promotional activities on social media are less costly, which is also an effect of advertisements made by consumers, expressed as word-of-mouth marketing. As previously mentioned, rather than the advertising activities carried out by businesses, the party that makes the actual marketing of the product has been consumers (Chaudhry, 2014).

Social media marketing is also one of the fastest and easiest ways to create brand awareness. Especially with the use of smart phones, consumers who spend most of their time on social media play an important role in creating this awareness (Chaudhry, 2014).

Social media platforms play a very important role in acquiring information about consumers. This information helps to convey the marketing messages to the right people. In other words, the businesses that follow the tracks of consumers in the virtual environment will be able to achieve success by offering the correct messages to the right people. By following the tracks of potential consumers, it will also be possible to reach new customers (Chaudhry, 2014).

Social media marketing provides businesses the opportunity to market their products and helps businesses to address their customers' suggestions and opinions. Through social media, the businesses that reach the masses can increase the sales of their goods and services (Neti, 2011).

Informal communications with the target market through social media bring the parties closer together and facilitate the marketing activities of the products. Close relationships with people through social media will enable businesses to create appropriate marketing campaigns aimed at the appropriate consumers. For example, when a consumer who is constantly purchasing the same product sees a campaign for the relevant product, or when a new product similar to that product is introduced by a business, such a product can be announced to the consumer (Whiting & Deshpande, 2014).

Through social media marketing, businesses have been able to reach consumers 24 h a day, 7 days a week. In addition, using social media provides businesses with a strong brand image and prestige. The marketing activities of the businesses also include activities that started before the sale. Using social media, businesses have been able to bring the voice of the customer into the business. This makes it easy to design and produce products that can meet consumer demands and needs. In other words, at the design stage of a new product, by using the feedback of the customers, businesses can create suitable products for their target markets (Koçak Alan, Tümer Kabadayı, & Erişke, 2018).

Social media marketing has a flexible structure. Hereby, changes that need to be made in the marketing mix elements will be performed very quickly (Şahin et al., 2017). For example, changing the prices of the goods and services according to the macro environmental factors can be easier on social media than in the traditional market.

Social media marketing allows consumers and businesses to compare goods and services with each other (Şahin et al., 2017). Businesses have an opportunity to make this comparison from various angles. Similarly, consumers can make some comparisons to choose the product that can best meet their needs and wants. It is known that this comparison affects consumers' decision-making processes in a positive manner.

As a result of a worldwide study in January 2018, the benefits of using social media for marketing purposes are as follows: increased exposure (87%), increased traffic (78%), generated leads (64%), developed loyal fans (63%), marketplace insight (54%), improved sales (53%), increased business partnerships (49%) and increased thought leadership (46%) (https://www.statista.com/statistics/188447/influence-of-global-social-media-marketing-usage-on-businesses/).

In addition to the advantages of social media marketing, it is possible to discuss its disadvantages. The major disadvantages of social media marketing can be examined with a focus on five main issues. These topics include being time-intensive, trademark and copyright, trust, privacy and security, user-generated content, and negative feedback issues. Social media marketing is time-sensitive, and if businesses do not control social media marketing, it can be a problem. One of the most important features of social media marketing is that it is open to two-way communication. This situation requires that every business benefiting from social media respond to the comments made by consumers and to the questions about the product in a timely manner. Otherwise, consumers who cannot find an answer can feed negative thoughts about the business. Sometimes, trademark and copyright issues may arise as a disadvantage to businesses in social media marketing. Businesses that use social media as a tool for marketing their goods and services should take the necessary precautions to protect their brands, goods and services against malicious people. Another problem in social media marketing is related to trust, privacy and security. Confidence in the virtual environment is still not fully satisfied. For this reason, consumers do not want to share their information with another party. Traditional marketing can be seen as safer by consumers. The most important reason for this is the possibility of face-to-face communication between the salesperson and the customers at the sales stage. Sometimes user-generated content may also be a disadvantage to businesses in social media marketing. It must be admitted that user-generated content has more of an influence on other consumers. At this point, it is very important for businesses to address such content. In addition, it should also be remembered that negative feedback may be a disadvantage for businesses in social media marketing. In social media marketing, where consumers are actively involved, comments shared by unhappy customers will affect both the existing and potential customers' thoughts about the businesses. Therefore, following unsatisfied customers, communicating with them on social media and providing necessary motivating answers or attempting to solve their problems will have a direct impact on the success of the businesses in social media marketing (Nadaraja & Yazdanifard, 2013).

7.8 Social Media Marketing Process

Today, social media plays an important role in the marketing activities of modern businesses. However, every business that benefits from social media may not be successful in social media marketing. The success of businesses in social media marketing depends on the proper and controlled implementation of the social media marketing process. In short, if there are steps to be followed in planning the process of marketing activities in traditional marketing, a similar situation applies in social media marketing.

The social media marketing process consists of several steps. The steps of social media marketing, in short, "L-I-S-T-E-N", include listen, identify, solve, test, engage and nurture (Narcı, 2017). Listening is one of the most important parts of social media marketing. In this way, the business will listen to the consumers' positive and negative criticism on social media platforms, and thus, they will be able to make marketing plans by coming to a conclusion (Miranda, Young, & Yetgin, 2016). The second stage in the social media marketing process is identifying. The way to succeed in this process is related to success in the previous stage. On the basis of what the companies are listening to on social media, they need to identify information about their goods and services on social media in a way that is appropriate for the target market (Narcı, 2017). Solving is the third step of the social media marketing process. As stated in the previous sections, social media marketing has brought a new breadth to customer relationship management. At this stage of social media marketing, empathy should be attempted with customers, and the problems raised by the customers should be solved (Narcı, 2017). It is not enough for businesses to find solutions for the current problems. For this reason, testing is important in the social media marketing process. In other words, the solutions found need to be tested to see if they work. The best way to do this is to listen to the customers (Narcı, 2017). Today, it is very important to create brand loyalty in a highly competitive environment. At this point, the social media platform has an important place creating brand loyalty. In the engaging stage, businesses can use social media to establish intimate and strong emotional ties with consumers (Koçak Alan et al., 2018). The way to do this is to use the creativity of the businesses. The last stage of the social media marketing process is nurturing. Some of the opportunities that will be offered by businesses to consumers during the nurture stage of the social media marketing process that establish an individualized connection with consumers will further strengthen the degree of this connection (Narcı, 2017).

As can be understood, the social media marketing process is actually a loop. The steps in the process look similar to a chain, with links that are connected to one another. If one of the links of this chain breaks, the chain will break down. In a similar vein, it is important to remember that all the steps in the process of social media marketing, such as a chain, are closely linked to each other. As a result, the success of social media marketing is based on the fact that processes such as the links of a chain are closely connected.

7.9 Consumer Behaviour in Social Media

Today, consumers are at the centre of marketing activities. Understanding and offering value to consumers who play a triggering role in the movement of businesses play an important role in modern marketing activities. In this context, businesses are trying to understand the behaviour of consumers, although it is not so easy. Solomon (2006: 7) defined the concept of consumer behaviour as "the study of the processes involved when individuals or groups select, purchase, use, or dispose of products, services, ideas, or experiences to satisfy needs and desires."

Currently, developments in technology have also affected the behaviour of consumers. In traditional marketing, consumers select, purchase, use or dispose of the goods and services in physical environments. However, with modern marketing, they have now begun to perform these activities by using social networks. In the related literature, the analogy of the consumption market for social networks is used. Thus, social networks have assumed the role of the consumption market. Through the use of social networks, consumers have been freed from being alone in the processes of selecting, purchasing and using the products and services. Consumers who are not alone in the decision of selecting and purchasing processes have started to provide the same support to other consumers via virtual environments after using the products. In particular, user-generated content, blogs and forums have been instrumental in helping consumers to refer products to each other (Terkan, 2014). In addition, individuals belonging to Generation Z are trying to make use of technology as much as possible in their daily activities as consumers. It is almost impossible to think of Generation Z as disconnected from social media. Considering the effects of the individuals belonging to Generation Z and the effect of their families on purchase decisions, it is known that these individuals exhibit different behaviours than the consumers in Generations X and Y (Horuztepe, 2018).

Factors affecting consumer behaviour, such as cultural, psychological, social and personal factors, also have an effect on consumer behaviour in social media. For this reason, it is necessary to take care of these factors when businesses are preparing their social media marketing activities and developing the strategies that will be used (Bayazıt Hayta, 2013; Rani, 2014).

Social media has significantly affected consumer behaviour and consumer decision-making processes. As a result of a previous study, it was determined that virtual communities have gradually become increasingly accepted by consumers, replacing advertisements sent by mail, salespeople, and even brochures to a certain extent (Jepsen, 2006). As a result of a study conducted on university students, it was found that social media had significant effects on both pre-purchase and post-purchase behaviours (Sarıtaş & Karagöz, 2017).

It is possible to examine the effects of social media on consumer behaviour based on three basic points. These points can be listed as follows:

- Behaviours that have an impact on the consumer's consumption.
- Given information and suggestions of the other consumers about the products and services that affect the consumption behaviour of consumers.
- Consumer behaviours related to expressing thoughts about products by using social media platforms (Bayazıt Hayta, 2013).

Since technology has entered our lives, significant effects on consumer behaviour have emerged. At this point, businesses that analyse consumer behaviours in a social media environment will succeed, and others will fail. As is understood from all these accounts, social media is a tool that cannot be denied in terms of today's businesses.

7.10 Emerging Social Media Marketing Activities in the Digital Age

Through the transition to the digital age, significant developments have occurred in the marketing activities of businesses. Businesses are trying to reach their target audiences and influence their potential customers through marketing activities carried out in this period. Compared to traditional marketing, marketing activities in the digital age are much more interesting and attract more consumers in the marketing process of products. In this section, viral marketing, influencer marketing and electronic customer relationship management (E-CRM), which are among the main marketing activities that have emerged with social media, will be examined briefly.

7.10.1 Viral Marketing

The expansion of the internet and the development of social media have changed word-of-mouth advertising activities in traditional marketing. This change caused viral marketing to start sprouting. Kaplan and Haenlein (2011: 255) defined the term viral marketing as "electronic word-of-mouth whereby some form of marketing message related to a company, brand, or product is transmitted in an exponentially growing way, often through the use of social media applications."

The concept of viral marketing was first included in the article "The Virus of Marketing" in 1996, and thus, the concept was introduced to the marketing literature. There is an analogy between a virus and viral marketing. The main reason for this analogy is related to the spreading of electronic messages quickly (Rakić & Rakić, 2014). In fact, individuals who send electronic messages in viral marketing are taking on the role of the salesperson of the business by spreading the messages rapidly among themselves and taking part, personally, in the marketing activities of businesses (Argan & Tokay Argan, 2006). It is also a fact that consumers take more notice of messages from other people, such as consumers similar to themselves, than those sent by businesses. For this reason, viral marketing is a more effective way of promoting goods and services than third-party advertising (Jurvetson, 2000).

In short, among the main advantages of viral marketing are the low cost, reaching a large number of people, being more convincing, enhancing brand awareness, and the ease of changing messages (Khaneja, 2016). On the other hand, the major disadvantages of viral marketing are damage to a brand, difficulties in measuring the effectiveness of a marketing campaign, reaching the wrong customers with viral videos, not being noticed by target markets of the viral videos, being met by a negative reaction, and the possibility of not being able to access consumers that do not use such technology (Chopra, 2017).

Recently, many viral marketing activities have been carried out for commercial and social purposes. One of the most famous of these activities is the Ice Bucket Challenge. The main aim of this campaign was to create awareness of ALS disease and attract attention to viral videos. In this context, between June 2014 and September 2014, over 17 million Ice Bucket Challenge videos were shared on Facebook. At the end of the period, it was determined that more than 440 million people watched these videos on social media (Phing & Yazdanifard, 2014).

7.10.2 Influencer Marketing

As a result of the widespread use of social media, a new marketing tool, called influencer marketing, emerged. After a certain period of time, influencer marketing started to be used by businesses as a shining star, especially with the change in the resources of consumers in the information collection phase. Consumers now rely more on interpersonal sources and take into account information from these sources in the purchasing decision process (Veirman, Cauberghe, & Hudders, 2017).

Influencer marketing is "a process of identifying and activating individuals who have an influence over a specific target audience or medium, in order to be part of a brand's campaign towards increased reach, sales, or engagement (Sudha & Sheena, 2017: 16)." In influencer marketing activities, social media is indispensable. Influencers use social media networks such as YouTube, Twitter, Facebook and Instagram to attract the attention of consumers towards specific products and brands (Glucksman, 2017). The selection of celebrities, and especially those with a high number of followers, in the selection of the influencer will increase the confidence and persuasion of the messages presented (Mert, 2018).

Influencer marketing has some advantages and disadvantages. The major advantages are relationships based on trust between the influencer and followers, high reach, and quick and easy access to feedback. On the other hand, selecting the wrong influencers, reaching the wrong people and the cost of advertising on YouTube are among the disadvantages of influencer marketing (https://socialmediaagency.one/criticism-influencer-marketing-disadvantages-hypes/).

Coca-Cola is one of the brands that has benefitted from influencer marketing activities. In the 1920s, by using the Santa Claus figure, the company attracted the attention of consumers to sell their product. In fact, this advertisement is considered to be one of the oldest examples of influencer marketing (https://alphaconcepts.co/blog/coca-cola-humanizing-products-through-influencer-marketing/). Today, Coca-Cola continues its influencer marketing activities.

7.10.3 Electronic Customer Relationship Management (E-CRM)

Today, E-CRM is one of the most effective ways for businesses to communicate with their customers. Through developments in technology, businesses that communicate with customers by using traditional channels have begun to establish this communication on an electronic platform.

E-CRM "is the implementation of e-technology or internet-based technology in order to attain customer relationship management (CRM) objectives (Nikou, Selamat, Yusoff, & Khiabani, 2016: 1133)." The major aims of E-CRM activities are enabling strong relations with customers by improving customer services and maintaining relationships with the potential and key customers of the company.

Through E-CRM, low-cost communication is established with consumers. In addition, it becomes possible to provide some suggestions, customized solutions and support. For example, Amazon offers suggested books to returning customers based on their past visits and purchases (Kennedy, 2006).

Today, businesses have become closer to their customers through social media. The use of social media in customer relationship management has further increased customer loyalty and allowed for feedback to be received in a short period of time. However, using social media in CRM also creates some problems related to the privacy of user data (Patil, 2014). As a result, it would not be wrong to say that E-CRM makes life easier for businesses.

7.11 Conclusion

After the transition to the digital age, significant changes occurred in the lives of businesses. Technology is now the main tool of these businesses. The digital age and technology have created the concept of social media for businesses. In this way, it is effective for consumers to use social media intensively for the purposes of entertainment and access to information.

Since the emergence of social media, some of changes have been made in the activities of businesses. Social media network services enable businesses to open many doors in the digital age. Such intensive use of social media has paved the way for a new trend called social media marketing. Businesses that have started to use social media in marketing activities have removed a large part of the difficulty they encounter in traditional marketing activities. Most importantly, social media marketing has increased the sincerity in the relationships between businesses and customers, and the messages have been directed to the appropriate consumers. The slogan of the right message to the right consumer enables businesses to realize their marketing activities based on the principle of cost effectiveness. In short, social media marketing has become a useful tool in the lives of businesses; as such marketing has many advantages. After a while, social media marketing diversified the marketing activities of businesses. Marketing activities such as viral marketing, influencer marketing and E-CRM have emerged in the modern business world. After a while, the companies that use these activities in a proper and controlled manner have begun to achieve significant success.

As a result, it seems that social media marketing has become an important factor for businesses. Therefore, the use of social media in the marketing activities of a company can be expressed as an important point to consider.

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Chapter 8
Transformation of Supply Chain Activities in Blockchain Environment

Goknur Arzu Akyuz and Guner Gursoy

Abstract Blockchain is one of the breakthrough technologies having the potential to dramatically transform the supply chains. In this study, potential impact of the blockchain technology on the supply chain management (SCM) will be investigated to reveal the nature of transformation that it can result in the domain. Based on a comprehensive review of recent literature at the intersection of blockchain and SCM, effects of blockchain on SCM are analysed under four titles: (a) basic characteristics, (b) transparency/visibility and traceability, (c) automated controls with smart contracts; and (d) trust-building and collaboration. Findings reveal that the technology is expected to provide accurate and trustable transaction infrastructure as well as true visibility and traceability across partners. With its potential to provide a transparent and trustable multi-partner ecosystem, it appears that blockchain will accelerate and strengthen the realization of a collaborative, IT-based network paradigm. Hence, findings of the study support that the blockchain technology will be a critical enabler of the transformation of the supply chains into tightly coupled, transparent collaborative ecosystems.

8.1 Introduction

The dual interplay between the technological developments and the business world is one of the most prominent factors in the development of contemporary and web-based supply chain management. Combined use of various IT (information technology) advancements, such as web services, cloud technology and mobile technology, led to advanced enterprise application integration systems which

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provide heterogeneous, platform-independent and web-based integration across multiple supply chain partners (Akyuz & Gursoy, 2013). This elevated the collaboration opportunities among partners to totally unprecedented levels and resulted in a web-based collaborative network paradigm as opposed to an enterprise-centric one.

Recently, blockchain technology is one of the most attention-grabbing and disruptive technologies from supply chain management (SCM) perspective. The technology, which has still 5–10 years to its widespread assimilation according to Gartner Group (2017), is a breakthrough by its “open ledger” perspective (Kamble, Gunasekaran, & Arha, 2018). It is projected to change the way real-time transactions are processed and exchanged among the enterprises, and open up ways to reengineer the high cost and inefficient processes.

Although the initial affects have been seen in financial products/services and frequently been cited along with bitcoin, today the technology has started to affect all of the sectors. Various studies are being made for applications in adverse range of sectors such as banking, energy, logistics and agriculture (Deloitte Turkey and TUSIAD, 2018). Applications in retail, healthcare, automotive and manufacturing and energy sectors are supported (DHL and Accenture Report, 2018). Deloitte Turkey and TUSIAD (2018) support that sectors that will be mostly affected by the technology are finance; information technology; and logistics and supply chain. Various other literature items also repeatedly highlight that logistics and supply chain domain is one of the major areas to be radically transformed by this technology (DHL and Accenture Report, 2018; Kshetri, 2018; Perboli, Musso, & Rosano, 2018; Treiblmaier, 2018).

It is supported in the literature that the blockchain technology has the potential to serve for the key SCM objectives of speed, flexibility, cost, quality, dependability, risk reduction and sustainability (Kshetri, 2018). Eliminating asymmetric information and inefficient processes across partners; ensuring the compatibility of infrastructure and processes; guaranteeing end-to-end traceability across partners; and managing partnerships among partners have always been the main issues in SCM context (Deloitte, 2017). They all serve for the collaboration and integration, and they hinder the collaborative long-term partnerships if not successfully handled. Thus, blockchain appears to be the key technology having the potential to address these basic supply chain management issues.

Complemented with the smart contract mechanisms, the technology is expected to provide accurate and trustable transaction infrastructure as well as true visibility and traceability across companies (Perboli et al., 2018; Pilkington, 2016). It also has the potential to resolve the trust problems in a supply network context (Kshetri, 2018). As such, it is interpreted to become the backbone of the digital supply chains.

In this study, potential impact of the blockchain technology on SCM is investigated. A comprehensive literature review is offered to reveal the nature of transformation that it can result in SCM, and key SCM concepts to be affected by the technology. Section 8.2 offers the review at the intersection of blockchain and SCM. Section 8.3 offers the discussion, and Sect. 8.4 contains the conclusion and further research suggestions.

8.2 Blockchain and SCM Concepts

This section offers a comprehensive literature review at the intersection of "blockchain" and "supply chain management" topics. Resources included in this study mainly cover articles from indexed and proven journals, as well as valuable white papers and web resources (such as Gartner Group and Deloitte reports). Due to the recency of the topic, majority of the resources in the reference list fall into 2016–2018 date range, with only few items from 2013 and 2014.

Our literature review highlights that there are a number of blockchain properties that are directly and perfectly relevant to SCM domain. The following table (Table 8.1) summarizes the main issues related with the blockchain technology, their relevance to main supply chain concepts, and the potential efficiencies and benefits that can be obtained by the technology along with the supporting references from literature. In this table, main issues are organized under the following subtitles:

- Basic characteristics
- Transparency/ visibility and traceability
- Automated controls with smart contracts
- Trust-building and collaboration

Subsections under this section are organized in parallel to these subtitles, and discussions are made under each subtitle.

8.2.1 Basic Characteristics

The main characteristic of the blockchain technology is to provide an immutable and irreversible record infrastructure in which clear identification of the source of transaction is possible. With the self-sovereignty characteristic, users identify themselves while maintaining control over the storage and management of data (Akyuz & Gursoy, 2018). Time-stamped and authenticated records are written and stored permanently on a general ledger. Irreversible, immutable and incorruptable records are provided with no possibility of altering or unauthorized modification (Casey & Wong, 2017; Deloitte, 2017; Findlay, 2017; Perboli et al., 2018). With these time-stamped, authorized and incorruptable properties, blockchain technology ensures clear accountability of the transactions. Exact timing and the accountability of the transactions can be reached accurately.

This incorruptable open ledger structure is a fundamental paradigm shift in processing the transactions across multiple parties. A digital ledger of real-time transactions can be obtained for all the supply network stakeholders (Kamble et al., 2018). Security concerns are handled as well by the compounded use of encryption/decryption mechanisms, public key infrastructure, consensus protocols, and the enforcement of complex permission mechanisms (Deloitte Türkiye and TUSIAD, 2018; Perboli et al., 2018). Hence, a single-version-of-truth copy of the

Table 8.1 Summary literature review table

Main issues related with the blockchain technology	Supporting Studies	Description	Relevance to supply chain concepts	Efficiencies and benefits that can be obtained
1. *Basic characteristics*				
Irreversible, immutable and incorruptable records	Findlay (2017); Casey and Wong (2017); Deloitte (2017); Perboli et al. (2018).	– Time-stamped, authenticated and chronological records written and stored permanently on a general ledger (open distributed ledger) – No possibility of altering or unauthorized modification of the records – Preventing fraud, corruption and falsified information	– Provides a trustable and permanent transaction infrastructure across partners. – Ensures single version of truth across the network – Enables continuity and accessibility of information – Provides the link between physical and financial flows	– Forms the base for joint management information systems (MIS) across partners – Forms the basis of business intelligence, joint reporting and controlling across partners
Accountability	Kshetri (2018); Casey and Wong (2017)	– Transactions performed by self-sovereignty (users identifying themselves while maintaining control over the storage and management of data). – Clear identification of the source of the transaction	Knowing who is performing what actions in the supply chain	Relevant partner within the chain can easily be identified
Security	Deloitte and TUSIAD (2018); Perboli et al. (2018).	– Allows encryption and decryption – Allows the enforcement of complex permission mechanisms – Public key infrastructure and consensus-based protocols – Cryptographically sealed	– Secure access across multiple partners	Secure and encrypted transaction exchange across partners

Trust on transactions	Kamble et al. (2018), Findlay (2017), Casey and Wong (2017)	– Persistent and trustworthy records – A medium which mediates trust	– Trustworthy transaction base that can be shared across multiple partners. – A trusted medium for information exchange	– Forms the base for collaborative planning, forecasting & replenishment. – Forms the base for further trust development across partners
Disintermediation	Kamble et al. (2018); Findlay (2017); Perboli et al. (2018).	– Platform for peer-to-peer transactions – No third-party intermediary is required	– Eliminates the need for any intermediaries to handle material, information and money-related transfers	– Accelerates the physical and financial processes – Provides chance to develop one-to-one collaboration
Scalability	Perboli et al. (2018).	Ability to scale the system up or down	System is elastic with respect to the size of the network	Ease of supplier on-boarding and exit
2. *Transparency/visibility and traceability*				
Transparency/visibility	Kshetri (2018)	– Visibility of physical distribution and financial aspects	– Provides instant and transparent transactional data for all the logistics and financial activities across partners – Serves for the basic supply chain objective of reducing the bullwhip effect across multiple partners – Directly relevant with the basic supply chain objective of providing visibility across multiple partners	– More transparency and visibility across supply chain partners, – Basis for collaborative planning, forecasting and replenishment
	DHL and Accenture (2018)	– Reducing information assymetry and providing single version of truth		
	DHL and Accenture (2018); O'Leary (2018).	– Elimination of manual and inefficient operations and paper-based documentation for logistics processes, especially for customs-related ones		
	Nakasumi (2017); DHL and Accenture (2018).	– Leaner, more automated and error-free processes		
Traceability	Ivanov, Dolgui, and Sokolov (2018)	Real-time tracking of material, money and information flows.	– Directly relevant with the main supply chain objective of obtaining full traceability of the item across all stages of the chain	Enhances the scale and scope of tracking and tracing systems

(continued)

Table 8.1 (continued)

Main issues related with the blockchain technology	Supporting Studies	Description	Relevance to supply chain concepts	Efficiencies and benefits that can be obtained
Tracing the origin of the product	DHL and Accenture (2018).	– Tracking the source of the item and verifying provenance – Serial number tracking in pharmaceuticals.		– Increases product safety
	O'Marah (2017a), O'Marah (2017b), Perboli et al. (2018), Kshetri (2018).	– Fresh food and agriculture: – Are foods organic? Fresh and locally sourced ingredients? Farm produced in? – Tracking fish and seafood products by mobile phones, blockchain and smart tagging	– Directly relevant with the efficient traceability of the supply chains – Specifically related with the supply chain dealing with products in the food and agriculture sector	– Develops trust on the items (trust on the origin, ingredients, freshness, shelf life and contamination) – Increases trust on the brand image of the company
	Ivanov et al. (2018), Galvez, Mejuto, and Simal-Gandara (2018), Kshetri (2018)	– Food safety (tracking the ingredients, expiration date) – Wallmart blockchain application for tracking down the contaminated food sources and food safety		– Helps reducing product recalls
	De Jesus (2016), Higgins (2017), Kharif (2016)	– Food recall	– Directly related with customer service quality and traceability of the after-service products	– Increases customer service quality
	Perboli et al. (2018)	– Fresh food use case		

	Preventing fraud and counterfeiting across the supply network	Kshetri (2018)	– Fighting fraud and counterfeiting	– Crucial for the supply chains dealing with items such as precious goods (jewellery), fine wine, expensive fashion goods and drugs	– Helps managing the risks of fraud and counterfeiting across the supply network
		Casey and Wong (2017)	– Providing unique identifying data on valuable items (diamonds)		– Gives the customers the confidence that the product is genuine
		Deloitte (2017)	– Fraud detection		– Affects the long-term reputation of the brand
	Handling special traceability requirements	Radanović and Likić (2018), Haq and Esuka (2018), Sylim, Liu, Marcelo, and Fontelo (2018)	– Medicinem (security and traceability of electronic health records and health research, efficient handling the drug supply and procurement processes; managing pharmaceutical drugs; fighting with falcified and substandard drugs	– Directly relevant to all the sectors requiring end-to-end traceability of serial numbers, lot tracking and expiration date follow-up – Especially relevant to supply chains dealing with medical items and food	– Provides efficient and real-time end-to-end traceability of items requiring special conditions throughout the logistics network – Enables real-time and automated control of special indicator and parameter
		Kshetri (2018), Perboli et al. (2018)	– Measuring the product quality indicators during transportation (eg. Temperature, humidity, light conditions, chemical composition) and checking thresholds – Batch number and serial number tracking – Checking expiration dates – Measuring travel path and duration – Maintaining cold chain for foods and drugs		

(continued)

Table 8.1 (continued)

Main issues related with the blockchain technology	Supporting Studies	Description	Relevance to supply chain concepts	Efficiencies and benefits that can be obtained
3. *Automated controls with smart contracts*				
Automated controls via smart contracts embedded in joint business processes	Lauslahti, Mattila, and Seppala (2017), Tania (2018), Boucher (2017), Ivanov et al. (2018), Cerasis (2018)	– Allows customizable and programmable logic to be stored in smart contracts – Algorithmic, self-executing arrangements which can function automously – Rules for negotiated terms of agreement are stored, fulfillment is automatically verified and then terms agreed-upon are executed – Consensus-based protocols and contracts embedded in automated processes	– Enables the enforcement of agreed-upon rules and automated conditions during any logistics or financial transactions. – Provides access to real-time validation of documents – Enables embedding dynamic features in the contracts. – Enables holding the vendors accountable. – Ensures adherence to service level contracts/agreements (SLA s).	– Smart process integration for logistics and financial movements – Guaranteed execution and fulfillment of multi-partner processes – Efficiency and automation of contract management cycle. – Helps handling the complication of contracts in SCs, such as the involvement of multi-party agreements, and the presence of various regulatory and logistics-related constraints. – Accelerating various regulatory processes such as customs. – Increasing the confidence in documentations.

4. *Trust-building and collaboration*				
Trust building among partners	Kshetri (2018), Deloitte Türkiye and TUSIAD (2018)	– Trust on transaction base – Trust is based on algorithms rather than on humans. Hence, it represents transformation of the trust model	– Enables trusted transaction base to be shared across partners – Enables trusted information and managerial reports across supply chain partners – Trust on the automated and accurate execution and control of multi-partner processes	– Increases trust on visible transactions, shared reports and joint processes – Enables the formation of joint, automated and trusted processes across partners
Collaboration	Akyuz and Gursoy (2018), DHL and Accenture (2018), McKendrick (2018), Silvestro and Lustrato (2014)	– Creating a culture of collaboration between all stakeholders – Creating an ecosystem of partners which can collaborate on key SC processes	– Brings all actors into a digital infrastructure – Enables collaboration without intermediation – Helps trust-building among partners – Provides opportunities of financial institutions to be trusted mediators of supply chain information.	Offers a trusted collaborative ecosystem

transactions (DHL and Accenture, 2018; O'Leary, 2018) is guaranteed across partners, with the assurance that the record is not altered or modified in any way.

With these characteristics, instant accessability and visibility of all the transactions across the partners is handled. As such, blockchain provides a "trusted transactional base" for the network for providing real-time, accurate and visible transactions among partners. This assumes a critical role in reducing the information asymmetry across the network, which is directly relevant to the most fundamental supply chain issue of the "bullwhip effect" (DHL and Accenture, 2018; Nakasumi, 2017; O'Leary, 2018). In supply networks, it is well-known that the cure to bullwhip effect is on-line and real-time information flow across partners. Thus, obtaining an accurate and real-time single-version-of-truth in a trusted transactional base across partners appears to be addressing the most fundamental supply chain problem of information sharing. This ensures the visibility and transparency of both material-related and financial-related transactions.

A trusted transactional database is also critical from management information system design perspective, since accurate, upto-date and real-time transaction processing ability is the key to any further reporting and business intelligence application development for across the network (Laudon & Laudon, 2016). A sound and trusted transactional base serves as the backbone of cross-enterprise reporting and business analytics generation. As such, blockchain can be the unique information source for integrating all supply chain functions (Korpela, Hallikas, & Dahlberg, 2017). This undoubtedly addresses the problem of ensuring the compatibility and integration of heterogeneous management information systems of multiple partners. As such, blockchain has the potential to become the foundation for collaborative planning, forecasting and replenishment (CPFR) philosophy (VICS, 2004).

Another basic characteristic of blockchain technology is to enable disintermediated transactions. Kamble et al. (2018); Findlay (2017); and Perboli et al. (2018) support that peer-to-peer transaction platform which does not require third-party intermediary involvement is provided. From supply chain perspective, this means elimination of intermediary parties from the transaction processing activities related with any material, information and money flow. Relevant processes can be accelerated and performed in a more efficient and leaner way, and this opens up true collaboration opportunities.

This characteristic is especially important for the financial transfers among the supply network partners, which require many intermediary financial institutions (such as banks and insurance companies) to become active players of the supply network. Blockchain technology offers the potential to execute the cross-partner financial processes in a more efficient way in synchronization with the material management processes. It guarantees secure and disintermediated financial transactions instantly shared across partners. In literature, there is ample support that financial integration of the chain in synchronization with the material movements is one of the key integration issues, which is rather difficult to achieve. With the priority given to the integration of the material management activities, financial integration is largely ignored (Silvestro & Lustrato, 2014). There usually happens a gap between the delivery of the physical item, invoice creation and payment settlement. The use of blockchain together with the smart contracts has the potential to integrate this gap and to simplify the financial operations (Kamble et al., 2018). In this regard, blockchain technology has a critical role in integrating and synchronizing financial processes across the network. It appears to be addressing the most fundamental and inherent problem of synchronizing the material-related and financial processes across the supply chain.

8.2.2 Transparency/Visibility and Traceability

It is evident from the table that maybe the most critical and primary purpose of using blockchain technology in SCM is to improve transparency and visibility of transactions (Ivanov et al., 2018; Kamble et al., 2018; Kshetri, 2018). Undoubtedly, possibilities of discrepancies in information flow increase as the supply chains become wider (Perboli et al., 2018).

The discussion in the above subsection has already revealed that blockchain technology can have a dramatic impact on reducing the information asymmetry across partners. It has the potential to provide instant and transparent transactional data for all the logistics and financial activities across partners. With this characteristic, the technology is directly relevant with the financial as well as physical material visibility (Kshetri, 2018). Ivanov et al. (2018) supports that real-time tracking of material, money and information flows are enabled by the technology. This is directly relevant to the main supply chain objective of obtaining full traceability of the item across all stages of the chain. Scale and scope of tracking and tracing systems are enhanced. Transparency and visibility of the end-to-end procurement cycle and full tracking of the logistics activities (including customs and international trade processes) are made possible.

DHL and Accenture (2018) support that elimination of manual and inefficient processes and paper-based documentation for logistics processes is possible; and in this way leaner, more automated and error-free processes can be enabled by the technology across the partners. This is especially valid for the customs-related processes, where extensive regulatory issues and legal paperwork are involved in a cross-border international trade environment along with the physical material movement. Such document-intensive processes are generally error-prone, and their lead times are long. Hence, making these processes leaner and error-free is a real improvement for increasing the overall efficiency and reducing the lead time of the end-to-end logistics cycle. In this context, blockchain also enables the traceability of travel paths and durations (Kshetri, 2018).

Evidently, numerous financial transactions and finance-related paperwork are in question along with the physical movements. In this regard, technology offers enormous opportunities for synchronizing the logistics and financial movements, which is in general one of the most critical sufferings of supply chain integration.

Both material and financial aspects can be synchronized in leaner, more transparent and error-free processes.

Under transparency/visibility and traceability heading, our literature review shows that following three main areas stand out:

- Tracing the origin of the product,
- Preventing fraud and counterfeiting across the supply network, and
- Handling special traceability requirements.

As can be seen in the table, these three aspects find significant support in the literature with various successful applications which have been already started. Each one of these three issues will be discussed in the following subsections.

Tracing the Origin of the Product

Tracking the source of the item and verifying provenance is one of the most frequently supported applications of blockchain (DHL&Accenture, 2018; Kshetri, 2018). This issue is of importance, since knowing the exact origin and being sure of the origin is especially important from the customer perspective in various sectors. The typical ones are fresh food and agriculture. In these sectors, it is very critical to answer the questions such as: “are the foods organic?”; “are the ingredients fresh and locally sourced?”; “in which farm is this item produced?” (O’Marah, 2017a, 2017b; Perboli et al., 2018). Blockchain is the solution to answer these questions by labeling the products in an unalterable way right at the source with the relevant dates (harvest date, processing date, expiration date, packaging date etc.), ingredient and the source information. These original records are carried throughout the journey of the product across all the logistics stages (transportation, warehousing, distribution, and delivery) until the customer receives the item. Therefore, the customer is sure of the basic information about the product upon receipt.

In this context, a number of resources clearly support the applications in food safety (Galvez et al., 2018; Ivanov et al., 2018; Kshetri, 2018). Wallmart application of using blockchian for tracking down the contaminated food sources and food safety again stands out in the literature (De Jesus, 2016; Higgins, 2017; Kharif, 2016).

Preventing Fraud and Counterfeiting Across the Supply Network

Related with tracing the origin of the product, another highly important idea under the traceability heading is the use of blockchain for preventing fraud and counterfeiting across the supply network. Since the origin of the product can be accurately identified with the trust that it is not altered in any way, this knowledge can be used to check the originality of the product to prevent fraud and counterfeiting across the network (Kshetri, 2018). This is directly relevant to supply chains which deal with items such as precious goods (jewellery), expensive fashion goods, fine wine, and drugs. Casey and Wong (2017), for example, mentions providing unique identifying data on valuable items (diamonds). In such sectors, originality of the product is a critical issue. Falsified, substandard and counterfeit products represent a critical risk, since it endangers the brand image and reputation for a number of products. In this regard, it harms all the partners involved in the chain. In drug sector risk is even more important, since the use of a product which is not original represents harm to people's health.

In this connection, blockchain appears to be a promising technology to give customers the confidence that the product is genuine. Originality-related information (producer, production date and all the related details) can be controlled throughout all the logistics cycle. Counterfeiting and related fraudulent action can be detected at any stage of the material management cycle. Thus, all the related risk can be minimized through the network.

Handling Special Traceability Requirements

Blockchain technology appears to be a perfect fit for handling various special traceability requirements that can arise in different sectors.

Medical sector is maybe one of the most important of these sectors which can have special traceability requirements. Medical sector inherently requires medical data security privacy; traceability of the patient records, lot and expiration date control of pharmaceutical drugs and medical material, and special transportation and warehousing conditions for inventory items (such as special sterilized packages, special temperature and cold chain requirements). To meet such special needs, there are many successful applications that have already been put into practice. In the literature, various medical applications are supported such as: ensuring the accuracy and privacy of electronic health records, various health research studies, traceability and efficiency of drug supply and procurement processes, and fighting with falcified and substandard drugs (Radanović & Likić, 2018; Haq & Esuka, 2018; Sylim et al., 2018). As such, supply chains providing drugs and medical items appear to be one of the most promising areas of application for the blockchain technology.

Blockchain also allows us to measure some desired product quality indicators during transportation (eg. temperature, humidity, light conditions, chemical composition) and to check certain thresholds automatically. By this way, we can continuously check and ensure that the item is handled under the right conditions throughout its transportation and storage processes. Cold chain for foods and drugs is a typical example of this, as supported by Kshetri (2018). Similarly, perishability conditions can be automatically checked and expiration date control can be performed much more efficiently with blockchain technology. Again foods and drugs can be given as typical sectors that will benefit from blockchain application.

Blockchain is also useful for the supply chains where batch and serial number tracking are required. Serial number tracking is an essential part of the entire process, and end-to-end serial number traceability is a critical requirement in sectors like consumer electronics and military electronics. With blockchain, serial numbers assigned at the original source can be tracked efficiently and accurately throughout all the logistics and financial processes by all partners across the network.

8.2.3 Automated Controls with Smart Contracts

The use of smart contracts via blockchain represents the mechanism for embedding automated controls during blockchain transactions. Embedding the code in the blockchain enables transactions to be executed automatically in response to certain conditions being met, and this results in guaranteed execution (Boucher, 2017). Thus, smart contracts allow customizable and programmable logic to be stored in smart contracts; and represent algorithmic, self-executing arrangements which can function automously (Lauslahti et al., 2017). They can store agreed-upon rules according to the terms of agreement, fulfillment can be automatically verified, and then the agreed terms can be executed (Tania, 2018). This enables consensus-based protocols and contracts to be embedded in automated processes, and the creation of joint business processes across supply chain partners (Ivanov et al., 2018). Agreed business terms and conditions can be embedded in transaction database.

From supply chain perspective, enforcing agreed-upon rules and automated conditions during any form of logistic or financial transactions is made possible. This means automated controls for various parameters. Quantities, lot sizes, and special conditions that can be represented in the form of logical rules can be automatically checked at any point during logistics and financial transactions. This provides real-time validation of documents and contributes especially to document-intensive processes like customs clearance for increased accuracy and efficiency. It is well-supported that this mechanism is especially useful for accelerating the regulatory processes such as customs by increasing visibility and confidence in documentations across all stakeholders (DHL & Accenture, 2018; Ivanov et al., 2018).

The mechanism is also well-supported to help the establishment and execution of healthy contract management processes within supplier relationship management (SRM) context. Embedding the dynamic features into the contracts allows the execution of automated controls to check whether the contractual conditions are fulfilled during material and money-related transfers. This is especially useful for handling the complexities of SC contracts which often involve multi-party agreements with various regulatory and logistics-related constraints. Multiple contracts with variable contents can be managed efficiently and simultaneously with the guarantee that many automated checks are accurately made, a very significant improvement from supplier contract management perspective.

This automated and self-executed mechanism is also perfectly compatible with the aim of seamless integration of multiple smart warehousing and manufacturing systems into joint processes. Smart process integration for logistics and financial movements can be ensured. Consequently, algorithmic and automated transaction capability of smart contracts appears to have a great potential to become an essential component of IoT (Internet of Things)-based smart ecosystem across partners.

8.2.4 Trust-Building and Collaboration

Trust-building and collaboration among partners are the key concepts that affect the overall performance, competitiveness and the long-term survival of the network in the recent SCM literature (Akyuz & Gursoy, 2014; Hudnurkar, Jakhar, & Rathod, 2014; Ruel, Shaaban, & Wu, 2018). Ability to collaboratively plan, execute and monitor the key business processes with joint decision-making is the essential theme and the current paradigm of SCM. In this regard, Collaborative planning, forecasting and replenishment (CPFR) model philosophy is the prevailing understanding (Hill, Zhang, & Miller, 2018; VICS, 2004).

Intertwined with the collaborative paradigm is the well-proven concept of collaboration maturity, expressing that process scope of collaboration broadens, and the ability to collaborate at different processes evolves and matures in time (Akyuz, Gursoy, & Celebi, 2014). Starting with the operational-level management of the basic material management activities, partners develop collaborative planning, execution and control mechanisms at different processes. In time, they learn to collaborate at larger number of processes for more and more strategic-level issues such as risk management and performance management. Consequently, collaboration ability is broadened from operational-level to strategic-level decision-making during this evolution (Akyuz & Gursoy, 2019).

Providing instant, symmetric information by IT-based tools across partners is the key issue in collaboration philosophy. It is the basis for sharing plans, execution-level feedback, monitoring- related reports and early warnings for proactive and joint management of key processes. Therefore, integrating heterogeneous enterprise application systems and providing real-time, transparent information at operational, tactical and strategic-level management of processes are at the hearth of the multi-partner supply chain collaboration (Akyuz & Gursoy, 2013).

Along with the instant and symmetric information flow across partners, another key issue in supply chain collaboration context is trust. Trust-building across partners is the vital part of collaboration (Hudnurkar et al. 2014; Ruel et al., 2018), and treated as an integral part of collaboration maturity (Akyuz & Gursoy, 2014) in the literature. Development of trust across partners is a multi-dimensional issue which is affected by various both hard and soft aspects. Factors such as: duration of relationship; reputation of the partner; past joint experiences; alignment of business processes; interoperability of IT infrastructures; compatibility of organizational structures and cultures of the partners; compatibility of managerial and leadership styles, degree of commitment and shared values are all effective in determining the degree of trust for the relationship (Akyuz & Gursoy, 2014; Ruel et al., 2018). Transparency and visibility of operations, willingness to share information and knowledge, and openness in behavioral dimension are again critical aspects of trust development. The resultant trust level among partners, in turn, determines the long-term existence and success of the collaboration. Hence, long-term collaboration among partners is a multi-faceted issue that has technical as well as managerial and organizational aspects.

When considered in this context, summary table given in Table 8.1 indicates that blockchain technology serves for trust development and collaboration in SCM in multiple aspects. These aspects are discussed in detail below:

- The inherent blockchain characteristic of providing "trusted transactions that can be shared across partners" is maybe the most critical issue. Providing irreversible, immutable and incorruptable records; accountability and embedded security mechanisms all serve for guaranteeing a trusted transaction infrastructure.

  With these characteristics, all partners have the assurance that a certain transaction is accurate, unaltered, secure, and its source is clearly identifiable. All partners have real-time and symmetric access to data and information. As such, blockchain: (a) provides a trusted "single version of truth" for transactions among partners; (b) directly serves for reducing the bullwhip effect, which is one of the basic issues in SCM; and (c) acts as the secure basis of information sharing, which is the prerequisite for healthy collaboration. This inevitably brings trust to the infrastructure. Therefore, blockchain has a huge potential for establishing a sound and trusted infrastructure for collaborative planning, execution and control across partners.
- The inherent blockchain characteristic of "disintermediation" is important from collaboration perspective, since it provides opportunities to develop one-to-one collaboration.
- All the issues discussed under "transparency/visibility and traceability" heading directly serve for openness and transparency of the supply chain processes in the network.

  Real-time traceability of operations across partners is one of the most critical issues of collaboration, and forms the basis of CPFR. Blockchain appears to be making a very significant contribution in this regard, and seems to be elevating the end-to-end traceability to unprecedented levels. This becomes the foundation for updating the joint plans, getting instant execution-level information for joint follow-up of the operations across partners, and enables real-time and joint controlling mechanisms across partners. Entire set of logistics and financial operations become transparent to all of the partners, bringing transparency to all the joint processes. Same "single version of truth" is instantly shared across all the SC actors, and all partners can now trust that no other SC player is delaying or filtering any information.

  Efficient tracking of the source of the item and verifying its provenance ensures trust that the product is from the correct origin. All partners have symmetric access to an intact information related with the origin of the product. Hence all parties can trust on the origin of the product.

  Prevention of fraud and counterfeiting across the supply network directly serves for the elimination of corruption, misconduct and illegal issues across the network. This is again crucial to help trust-development among partners, since any opportunistic behaviour, abuse or misconducts is always detrimental to trust. Even one instance can destroy the trust among partners as well as the entire brand image. As such, blockchain infrastructure automatically becomes a deterrent factor for all the partners for such totally undesired circumstances. Thus, each partner can develop trust that no such corruptions or opportunistic behaviours are taking place in the network.

Assurance that all special traceability conditions are monitored and handled properly across the entire logistics cycle is again a very critical contribution to trust development and collaboration among partners. All logistics and financial players are given the assurance that lot numbers and serial numbers are not lost and they are tracked properly during entire set of operations across multiple partners. They have the confidence that cold chain conditions or other required storage conditions are not violated during the logistics activities, expiration date controls are handled automatically and any other quality requirement imposed is not violated. Clearly, this gives the assurance that some quality conditions are met throught the cycle. Definitely, this increases the trust on the quality and repeatability of operational-level joint processes.

- Smart contracts assume special importance from trust-development and collaboration perspective. By providing algorithmic, automated controls during transactions, smart contracts have the potential to minimize the manual interventions and human controls. As such, they have a significant potential to increase the trust on the flawless process execution. With all the algorithmic and automated controls embedded into the execution, partners can trust that all the necessary algorithmic checks are performed and validated on agreed-upon conditions. Document validations, checking technical condition, checking regulatory and legal conditions can all be embedded in the joint processes. Therefore, partners have trust that any embedded condition is automatically checked and validated during the process execution. This is growing confidence in the accuracy of the documents as well as accurate fulfillment of the joint processes. With these characteristics, smart contacts bring in a trust model which is not based on human controls but rather on build-in algorithms and automated controls. All the partners have the confidence that necessary checks are executed without any delay or human intervention.

Consequently, blockchain technology with smart contracts serves for trust development and collaboration in all of the above-describes aspects, offering a totally different trust model for the entire network. It brings trusted transactions, trusted automated controls during joint process execution, and trusted visibility and transparency. It minimizes the human element during transaction processing, and hence brings trust based on algorithms and automated controls. It also develops confidence that partners cannot engage in fraudulent actions or abuses, which are totally detrimental to trust. Undoubtedly, all these increase confidence on the product and on the public brand image.

8.3 Discussion

This study made it clear that blockchain complemented with smart controls has the potential to serve for the various SCM objectives in collaborative network setting by its inherent characteristics. It serves for: (a) providing symmetric information across partners and reducing the bullwhip; (b) increasing efficiency and accuracy of operations, which leads to operational excellence; (c) serving for the development of joint and efficient processes; (d) ensuring full visibility and transparency; (e) synchronizing the material management and financial aspects; and (f) increasing trust and collaboration and across partners.

Because of all these characteristics, the technology appears to be one of the greatest technological enablers of the collaborative SCM paradigm. The technology promises us a collaborative ecosystem with distributed transactions, distributed trust, and trusted joint processes with built-in smart controls. It has the potential to be the foundation for the joint management information system infrastructure for collaborative process planning, execution, control and managerial reporting. As such, it appears as one of the greatest enablers for the development of the collaborative mindset across the network.

Upto this point, it is clearly put forward that blockchain technology will radically transform the existing understanding of the visibility and traceability across the network. It has the potential to provide real transparency and full visibility of joint processes. As it has already been made evident, it has dramatic implications for the logistics traceability. Ensuring the accuracy and continuity of the key information across all the stakeholders, particularly lot numbers, serial numbers and various quality qualifiers, and obtaining real-time end-to-end traceability are now enabled. This appears as the remedy for the most fundamental problem of ensuring multi-partner traceability. Authors hold the opinion that this will be the greatest SC issue that blockchain technology will contribute to. Various examples of applications referenced in Table 8.1 apparently show that initial applications of the blockchain technology have started to mature in this direction.

Addressing the problem of "synchronizing the material and financial processes" will again be one of the most critical contributions of the blockchain technology to SCM domain. Ensuring such a synchronization will be a giant step towards an integrated and collaborative network. Financial players will come into the collaborative scene as fully integrated and synchronized partners along with other stakeholders, bringing in dramatic improvements in cross-partner financial-processes. Better managed contractual and legal conditions and automated controls embedded during transactions are expected to accelerate the entire financial cycle, increase the accuracy and trust on the documentation, and guarantee the proper execution and fulfillment of the end-to-end processes.

In previous sections, it is explained in detail that blockchain serves for trust development across the partners in multiple aspects, both technical and behavioral. From technical perspective, it provides a trusted infrastructure with accurate and automated transactions as well as trusted processes. It increases trust in the documentations and reporting as well as proper execution of the processes. From behavioral perspective, it helps trust development by deterring undesired partner behaviour such as fraud and counterfeiting. In the long run, this will definitely contribute to trust development across all the partners.

In this connection, it can be argued that blockchain has both direct and indirect positive effects on SCM collaboration. It directly serves for collaboration by ensuring information symmetry, accountability, automated controls and end-to-end-traceability. It indirectly contributes to collaboration via helping trust development, which is the biggest factor enabling a collaborative culture. Thus, direct positive effects of blockchain on SCM collaboration are reinforced by its effects on trust development.

8.4 Conclusion and Further Research Suggestions

This review study put forward that blockchain technology is expected to be a critical enabler of the transformation of the supply chains into tightly coupled, transparent collaborative ecosystems. The authors believe that inherent characteristics of blockchain together with smart contract mechanisms will make the technology a critical and essential component for smart object connectivity and traceability within the Internet of Things (IoT) philosophy. Smart controls embedded in the blockchain has the potential to be the most important catalyst for creating a smart collaborative supply chain system.

It appears that in the age of Industry 4.0, blockchain will be a crucial building block within the landscape of a smart collaborative SC ecosystem along with the other recent technologies such as 3D printing/additive manufacturing, robotics, sensors, autonomous vehicles and cloud computing.

Evidently, combined use of blockchain along with all these technologies promises a dramatic transformation and an entirely different SCM ecosystem. As the maturation and widespread assimilation of blockchain as well as all the above-mentioned technologies take place, a totally different SCM arena is expected to come into scene. It can easily be argued that this new arena in the age of Industry 4.0 will have the following characteristics:

- Use of robotics, 3D printers and full automation across the partners,
- Real-time data and information exchange among smart objects,
- Embedded smart controls among objects together with the use of smart algorithms and artificial intelligence applications,
- Full connectivity with cyberphysical systems.

Complemented with all the blockchain characteristics, the transformation that will be experienced in SCM will lead to a collaborative multi-partner ecosystem with full integration, visibility and traceability as well as perfect collaboration and synchronized processes. Such an environment will enable increased on-demand manufacturing and mass customization abilities, increased flexibility and responsiveness for the overall network. Inarguably, these are the most fundamental concepts for strategic-level success and long-term competitiveness of the supply chains.

This study made it clear that blockchain technology has already started to be, and will continue to be, a very important catalyst for a fully connected and collaborative ecosystem. Although various applications have already been initiated in different sectors, it is apparent that blockchain technology is still far away from maturity and wide-spread assimilation. In this regard, the authors believe that the topic of blockchain applications in SCM will continue to be a hot research topic for the near future. In this connection, authors believe that the following suggestions can be useful as further research avenues:

- Studies related with developing integration frameworks and architectures for SCM collaboration by using blockchain as part of a smart system ecosystem,
- Comparative studies within a specific sector or across multiple sectors for various traceability and visibility applications of blockchain,
- Security aspects, including the encryption/decryption mechanisms,
- Effects of blockchain applications on behavioral aspects of SC relationships (trust development across supply chain partners),
- Effects of various smart contract applications on contract management, long-term supplier relationships and service level agreements in different SC contexts,
- Business process reengineering studies focusing on the effects of blockchain on the process simplifications towards leaner multi-partner processes.

Consequently, the topic is open to further research from technical as well as organizational and behavioral aspects.

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Chapter 9
Digitalization in Logistics Operations and Industry 4.0: Understanding the Linkages with Buzzwords

Metehan Feridun Sorkun

Abstract The new industrial revolution, Industry 4.0, requires digital transformation in all business operations including those of logistics. The digitalization in logistics operations, such as transportation, warehousing, inventory planning, sourcing, and return can provide firms high levels of flexibility and efficiency that are key to competitiveness in the era of Industry 4.0. In this regard, many buzzwords (technologies) are discussed in the discourses of Industry 4.0, emphasizing their key importance for the successful digitalization of logistics operations. However, the lack of clear understanding on these buzzwords and their interrelations is a barrier to firms' determination of a clear road map for the digitalization process. For this reason, this study aims to initially introduce the Industry 4.0 enabling technologies (buzzwords), expected to be widely used in logistics operations in the immediate future, and then reveals the linkages between these technologies. To this end, this study applies the fuzzy-total interpretative structure modelling on the Industry 4.0 enabling technologies, which are big data analytics, internet of things, artificial intelligence, cloud technology, 3D printing, augmented reality, 5G connection, and autonomous vehicles. The results show that most Industry 4.0 enabling technologies are interdependent, but to different degrees. These results provide guidance on which technologies firms should primarily focus on to achieve digital transformation in logistics operations.

9.1 Introduction

Despite lack of consensus on its definition (Piccarozzi, Aquilani, & Gatti, 2018), it is undeniable that the Industry 4.0, empowered by the state-of-art technologies, is revolutionizing the entire production system, including the logistics operations (Hofmann & Rüsch, 2017). Industry 4.0, termed as the fourth industrial revolution,

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is the successor of the third industrial revolution, which allowed firms to automate their processes with the use of electronics and computers (Xu & Duan, 2018). As a further step, Industry 4.0 is making all work pieces smart by integrating physical and cybernetic networks through cyber-physical systems (Lu, 2017). In this setting, all work pieces are able to function autonomously but at the same time, cooperate with each other for the system-wide goal (Wang, Wan, Zhang, Li, & Zhang, 2016). This production system, emerging as a need for competing with manufacturing systems based on cheap labor (Erol, Schumacher, & Sihn, 2016), promises to provide a high level of flexibility and efficiency.

The revolution of Industry 4.0 is compelling firms to digitalize their operations in order to remain competitive. In this era, firms should be able to collect massive amounts of relevant data, and by exploiting the advanced analytic techniques, produce useful information (Govindan, Cheng, Mishra, & Shukla, 2018). Authorized people and work pieces should be able to access this information in near real-time, and make use of it to determine the best course of action. Such data-driven decision-making aligned with the system-wide goal is expected to improve efficiency and flexibility, leading to improved firm performance (Ramanathan, Philpott, Duan, & Cao, 2017; Yu, Chavez, Jacobs, & Feng, 2018). On this basis, the features of Industry 4.0 can be listed as digitalization, customization, optimization, adaptation, human-machine interaction, and automatic communication, while its principles are cited as traceability, trackability, interoperability, reconfigurability, virtualization, real-time capability, decentralization, service-orientation, integration, and modularity (Lu, 2017). In order to accomplish these features and principles, the necessary key technologic enablers (pillars) of Industry 4.0 are big data analytics, autonomous robots, simulation, the industrial internet of things, cloud computing, cybersecurity, the additive manufacturing, and augmented reality (Rüßmann et al., 2015).

Industry 4.0 cannot be put into practice without the digitalization in logistics operations, i.e. 'Logistics 4.0' or 'Smart logistics' (Douaioui, Fri, & Mabroukki, 2018). Hence, logistics is defined as the key enabler and central element of Industry 4.0 (Delfmann, Ten Hompel, Kersten, Schmidt, & Stölzle, 2018). Studies (Brinch, Stentoft, Jensen, & Rajkumar, 2018; Nguyen, Zhou, Spiegler, Ieromonachou, & Lin, 2018) reveal that the digitalization in logistics operations supports each supply chain function (plan, source, make, deliver, and return) by integrating all entities and processes. Accordingly, the advantages of digitalization starts with the planning function, such as optimal supply network design and improved forecasting (Chase, 2016). Its advantages are also observed in sourcing processes, including the supplier selection, evaluation, and integration (Jain, Singh, Yadav, & Mishra, 2014; Olson, 2015). In the same vein, the digitalization makes it possible to implement smart inventory and warehouse management systems that enhance the productivity of production processes (Georgakopoulos, Jayaraman, Fazia, Villari, & Ranjan, 2016; Hoehle, Aloysius, Chan, & Venkatesh, 2018). The efficiency and effectiveness of the delivery process also increases with digitalization, because smart transportation systems optimize the routing and scheduling, while also increasing vehicle utilization rates (Hopkins & Hawking, 2018). Similarly, the digitalization gives rise to efficiency in return processes, for example, by exploiting the product-in-use data (Andersson & Jonsson, 2018).

The realization of Industry 4.0 may be slowed for a number of reasons (Erol et al., 2016). The major factor, especially for the managers of small and medium sized enterprises, is the lack of clear understanding. Buzzwords, the popularly used terms in particular contexts, might gain the distorted meanings over time (Thornton & Ocasio, 2008). Thus, the linkages between the Industry 4.0 enabling technologies may not be sufficiently comprehended to encourage firms to take a strong step towards its adoption. Similar buzzwords are discussed during the discourses of Industry 4.0, such as big data, big data analytics, cloud computing, 3D printers, virtual reality, robots, automated guided vehicles, drones, and internet of things. Nevertheless, unless these buzzwords and their linkages are well-understood, it is not possible to formulate a proper strategy for the digitalization process. For example, knowledge that the massive amount of data collection is needed to remain competitive in the era of Industry 4.0, but inability to comprehend how the data collection activity is linked to the big data analytics and cloud technology prevents managers from visualizing a clear road map for the digitalization process.

In order to clarify what the digitalization in logistics operations should refer to in the era of Industry 4.0, this study aims to reveal the linkages between the Industry 4.0 buzzwords, considering their use in logistics operations. For this purpose, eight buzzwords were examined, adapted from the enabling technologies (pillars) of Industry 4.0 (Rüßmann et al., 2015), namely big data analytics, internet of things, artificial intelligence, cloud technology, augmented reality, 3D printing, 5G connection, and autonomous vehicles. This study used the fuzzy total interpretive structural modeling (fuzzy-TISM) to reveal the strength of linkages and the hierarchical structure among buzzwords from the viewpoints of a specific group of managers, the first Industry 4.0 application implementers in Turkey. The results uncover the strengths of relationships between the Industry 4.0 enabling technologies, and present a clear picture to managers committed to rapidly adapt their firms to the Industry 4.0 era by digitalizing their logistics operations.

The remainder of chapter is structured as follows. The next section introduces the enabling technologies of Industry 4.0, and their use cases in logistics operations. Then, the subsequent two sections explain the methodology and show its application respectively. After the results are reported, the last section discusses the implications of results, and concludes the chapter.

9.2 The Industry 4.0 Buzzwords and Logistics Operations

This section introduces the Industry 4.0 enabling technologies (buzzwords) and gives examples on their uses in logistics operations.

9.2.1 Big Data Analytics

The amount of data generated per year is approaching zettabytes (Tiwari, Wee, & Daryanto, 2018). Hence, the data has become a very important resource for firms whose competitiveness depends on the capability of harnessing it (Chen, Preston, & Swink, 2015). Firms should be able to employ complex analytic methods to this end, because the data intended to be exploited is not only very large, but also characterized by high velocity, variety, and variability (Sivarajah, Kamal, Irani, & Weerakkody, 2017). Big data analytics is gaining popularity in this regard, due to its capacity to collect huge amount of data from large variety of resources in different formats (e.g. GPS, ERP, RFID, social media, multi-media content and mobile devices), and convert these data into a usable form to produce insights (Hofmann, 2017). Big data analytics gives decision makers the ability to see the hidden patterns (i.e. what happened), foresee future events (i.e. what will be likely to happen), and influence these events by applying the appropriate actions (Gravili, Benvenuto, Avram, & Viola, 2018).

The use of big data analytics increases financial performance (Yu et al., 2018), supply chain performance (Gunasekaran et al., 2017), supply chain efficiency (Hofmann, 2017), and supply chain innovation capabilities (Tan, Zhan, Ji, Ye, & Chang, 2015). Studies (Brinch et al., 2018; Tiwari et al., 2018) report that big data analytics can be used in many logistics and supply chain activities, such as strategic sourcing, supply chain network design, demand planning, procurement, inventory, routing, and scheduling. An example given by Wang, Gunasekaran, and Ngai (2018) is the utilization of big data to determine the optimal number and locations of distribution centers ensuring low handling and transportation costs. Mishra and Singh (2018) show how twitter data can be used to decrease waste in supply chains. The analytic tool used by UPS exploits big data that helps cargo delivery drivers find the most appropriate route (Sanders, 2016). Andersson and Jonsson (2018) demonstrate that the exploitation of product-in-use data enhances the effectiveness of the spare parts planning and forecasting.

9.2.2 Internet of Things

Internet of Things (IoT) refers to the network of digitally interconnected physical items that can sense their physical environment and respond in a targeted way over the Internet. IoT enables both human-to-machine and machine-to-machine interaction (Ben-Daya, Hassini, & Bahroun, 2017). IoT is shown as the core component of Industry 4.0 (Hofmann & Rüsch, 2017), in this respect, it is also called Industrial Internet of Things (IIoT) in an industrial context (Jeschke, Brecher, Meisen, Özdemir, & Eschert, 2017).

IoT enables identification of all individual items within supply chain, therefore provides end-to-end supply chain visibility by instantly showing both the status and conditions of items (Tadejko, 2015). This ability leads to the improvements in the processes of shipment, inventory, warehouse, quality control, maintenance, security, safety, and reverse logistics. Monitoring the status (e.g. temperature, humidity) of products in transport via IoT technologies (e.g. radio frequency identification system) can guide the scheduling of deliveries. The utilization rates of trucks and drivers can be increased via the use of the telematics-enabled vehicles (Andersson & Jonsson, 2018). The IoT-enabled dynamic route optimization based on traffic and weather conditions increases the rate of on-time deliveries. The routing of vehicles can also be made based on the signals received from other items; for example, the RFID tags inserted into trash bins allow monitoring the level of waste, saving time and energy by directing the waste trucks only to full bins (Hannan et al., 2018).

IoT enhances the traceability of items within supply chain; hence, the suppliers responsible for quality problems can easily be detected (Georgakopoulos et al., 2016). It saves time by facilitating the identification of items and optimizing the routing for order picking, hence optimizes warehousing operations and improves inventory accuracy (Georgakopoulos et al., 2016). IoT ensures elevated security by alerting thefts, shrinkages, and unauthorized attempts to enter restricted areas (Fan, Tao, Deng, & Li, 2015). IoT enhances working conditions by providing safety (i.e. minimizing errors), for example, devices can report the fatigue level of drivers (Hopkins & Hawking, 2018) or signal warehouse employees' mistakes/errors (Georgakopoulos et al., 2016). IoT can also increase the employee performance by providing guidance on tasks (Georgakopoulos et al., 2016). In retailing operations, IoT alerts firms about the stock-outs and replenishment times (Parada, Melià-Seguí, & Pous, 2018). IoT technologies boosts customer satisfaction at the same time, allowing them to track their orders in near real time. Using the digital trace and locational data of consumers via IoT, firms can also provide more customized logistics service (Hoehle et al., 2018). Moreover, the product-in-use and asset-in-use data collected in real time allows the more effective planning of reverse logistics activities (Ben-Daya et al., 2017) and predictive maintenance (Uden & He, 2017).

9.2.3 Artificial Intelligence

Although artificial intelligence was first introduced over 60 years ago, only in recent years has it received intense interest with the advent of other technological advancements (e.g. Internet and big data), which enabled its power to be exploited (Pan, 2016). Artificial intelligence technology gives machines the human-like abilities of perceiving, understanding, learning, problem solving and reasoning (Gesing, Peterson, & Michelsen, 2018). In this way, it is possible to carry out routine tasks more effectively and efficiently. Furthermore, artificial intelligence technologies exceed the human level performance in complex tasks owing to these technologies' ability to harness advanced algorithms (e.g. deep learning algorithms with the use of neural networks) and high computational power (Brynjolfsson, Rock, & Syverson, 2018).

The white paper jointly prepared by DHL and IBM (Gesing et al., 2018) reports how artificial intelligence can be used to improve logistics operations, by assisting with detailed-oriented and repetitive tasks, for example, preparing customs clearance documents, in which a small mistake could be very costly. The systems using artificial intelligence (e.g. cognitive customs) can eliminate mistakes in these types of routine but detailed-oriented tasks; hence, prevent possible extra costs. Systems powered by artificial intelligence are also able to support complex decision-making, for instance, by analyzing large and wide variety of data, they are able to predict the delay of shipment for particular routes. Alternatively, they are able to reveal the items each consumer is likely to order. Based on these predictions, they can suggest the transport mode, routing, product assortment and inventory position in the supply chain, reducing delivery time and shipping costs. It is also known that artificial intelligence plays a major role in unmanned vehicle projects, which will soon be used in the last-mile deliveries (e.g. the delivery of commercial goods via drones).

9.2.4 Cloud Technology

Logistics management aims to manage effectively not only the flows of goods and services, but also the flow of information. The importance of ensuring effective information flow increases with the fourth industrial revolution which requires end-to-end supply chain visibility (Hofmann & Rüsch, 2017). However, there are challenges due to the non-standardized heterogeneous processes, geographically scattered operations, and seamed connectivity along supply chain (Jung & Kim, 2014). Another major concern in the era of big data is data storage (Wang et al., 2016); firms often lack time, human, and financial resources and IT expertise for the necessary expansion and maintenance of their IT systems (Daniluk & Holtkamp, 2015; Gupta, Kumar, Singh, Foropon, & Chandra, 2018).

Cloud technology supports collaboration and integration along supply chain by delivering IT solutions that enable efficient and effective information flow between supply chain members (Gomez, Grand, & Gatziu Grivas, 2015). Cloud technology can customize IT solutions for each firm's logistics problems (Daniluk & Holtkamp, 2015), and more importantly, enables IT-integration of the firm with its partners, customers, and suppliers for real-time information sharing (Gomez et al., 2015). Cloud technology is also a solution for the big data storage problem, because the scalable storage and use of data, possible with cloud technology, decrease the IT and maintenance costs of firms for hardware and software (Arunachalam, Kumar, & Kawalek, 2018; Gupta et al., 2018). Outsourcing the cloud service allows firms to focus on their core competences (Aktepe & Yaşar Saatçıoğlu, 2017; Li, Wang, & Chen, 2012). In 2020, it is expected that 37 percentage of all data will be stored in the cloud (Büyüközkan & Göçer, 2018). Although firms may consider this insecure due to the dangers of losing data and possible unauthorized accessing to confidential data, these risks can be minimized through the use of backup systems (Li et al., 2012) and different cloud configurations, such as public, private, and hybrid clouds (Arunachalam et al., 2018).

Cloud technology is being used to integrate many logistics operations. The paper of Gomez et al. (2015) exemplifies some of the cloud technology applications in the logistics industry; for example, in Hamburg port, the users can access information in real-time about weather conditions and accidents. Similarly, the container portals built on the cloud technology allows providers instant access to prices, offers, and route information. These type of cloud-based projects (e.g. a European project LOGICAL3) optimise capacity and resource planning by connecting all logistics providers and supply chain partners. Hence, cloud technology leads to the better forecasts, reduction of empty mileage, better planning of vehicle routing, lower levels of environmental pollution, and more deliveries on time.

9.2.5 Augmented Reality

Augmented reality enhances the working conditions and efficiency by illustrating digital visualizations and virtual information in the relevant places of real environment. Considering that human decisions, experience and fatigue play an important role in many logistics activities (e.g. order picking, storage, item delivery), augmented reality is an important technology that both decreases human error in logistics operations and accelerates their executions by giving workers enriched abilities and guidance (Cirulis & Ginters, 2013; Paelke, 2014). Wearable devices are being used for this purpose, exemplified by the warehouse of the food company whose workers use smart glasses for the order picking process (Vanderroost et al., 2017). The exploitation of augmented reality with such devices (e.g. head-mounted display, cameras) both speeds processes and provides instructions for unfamiliar tasks (Paelke, 2014). Benefits include reducing human errors (Vanderroost et al., 2017) and faster training for new employees (Cirulis & Ginters, 2013).

According to the DHL industrial report (Glockner, Jannek, Johannes, & Theis, 2014), augmented reality is currently being employed to improve warehouse operations, transportation planning, and last-mile delivery. The use of augmented reality in warehouse operations saves time and reduces costs by illustrating the optimal order picking path and sequence, while increasing logistics service quality by checking order completeness. Augmented reality also supports strategic decision-making (e.g. warehouse layout design) by virtually showing the possible layout modifications in the real warehouse facility with the minimum cost. Augmented reality also contributes to the effectiveness of transportation processes, guiding drivers how and to where to place each item (cargo) in the vehicle, and pinpointing the exact building for delivery (Glockner et al., 2014). Augmented reality devices give drivers information on the cargo conditions, which allows an immediate intervention in case of any significant change, e.g. temperature, humidity (Merlino & Sproģe, 2017). Moreover, augmented reality devices can be used to guarantee the delivery of item to the correct recipient (Glockner et al., 2014). The reverse logistics operations also exploit augmented reality technology. Consumers may not need to bring their problematic products to the store, since it is possible to identify problems and repair products by applying the augmented reality to a video stream (Merlino & Sproģe, 2017).

9.2.6 3D Printing

3D printing technology, also called as additive, digital, and fast manufacturing, is able to produce almost any item that has been digitally designed as a three-dimensional model (Rogers, Baricz, & Pawar, 2016). 3D printers can utilize recycled materials to produce high quality products with the minimum of materials and waste (DHL, 2016). 3D printing technology is capable of achieving mass customization by reducing the scope and scale advantages of traditional manufacturing (Sasson & Johnson, 2016). There are two views on 3D printing. One is that 3D printing is a revolution that will disrupt the conventional manufacturing processes (Mohr & Khan, 2015). The alternative argument is that the 3D printing will complement conventional manufacturing processes rather than having a disruptive effect (Sasson & Johnson, 2016). Despite these differences, both arguments point out that the use of 3D printing technology will significantly affect the global value chain and logistics operations.

3D printing is expected to remove some supply chain stages (e.g. second-tier suppliers, retailers, and distribution centers) because it enables a localized production close to the consumption points. Such localized and portable production will allow firms to access markets that are currently inaccessible due to their logistics challenges, e.g. high distance, risk, and danger (Sasson & Johnson, 2016). In addition, the localized production will enhance the logistics service quality, due to shorter lead times and the ability to provide higher levels of customization. Also, near-sourcing (i.e. localized production) realized by the 3D printing technology is expected to reduce shipment costs, safety stock levels, and import/export logistics costs (DHL, 2016). Moreover, the disintermediation of distribution centers and warehouses will decrease the need for an inventory of semi-finished and finished goods; rather, an inventory will be needed for raw materials feeding 3D printers, such as plastic, metal, and ceramic. This shift will lower the number of requiring stock keeping units (Rogers et al., 2016), which is expected to decrease inventory-carrying costs, eliminate assembly activities (i.e. decrease handling costs), and reduce the number of suppliers transacted with (i.e. decrease sourcing costs).

3D printing technology will also enhance the efficiency and effectiveness of the reverse logistics activities in three ways. First, the involvement of consumers in the design and production phases will decrease the product return claims. Second, reduced waste due to with 3D printers will diminish the need for waste collection and processing activities (Sorkun, 2018a). Finally, the 3D printed spare parts on-demand will save the inventory-carrying costs, while decreasing consumer waiting times, for example, Mercedes-Benz Trucks now uses the 3D-printed spare parts for this reason (DHL, 2016). Similarly, the company Fast Radius has established its 3D printing facility close to the cargo company UPS for faster product returns (DHL, 2016).

9.2.7 The Fifth Generation (5G) Mobile and Wireless Communications

Regarding the deficiencies in the 3G/4G mobile networks widely used today, Rao and Prasad (2018) list the current implementation limitations of Industry 4.0 as follows: (1) the wireless connection is not sufficiently reliable, (2) IoT devices consume excessive energy, (3) the connection latency is not low enough for predictable remote control, and (4) connection problems occur in case of high device density. Thus, the key enabler technology for Industry 4.0 is considered to be 5G, which will provide very high reliability (greater than 99.99%), low energy consumption, ultra-low latency (less than 1mS), high flexibility, and large bandwidth (billions of devices can communicate and operate remotely in real time) (Rao & Prasad, 2018). These features are especially critical for the tracking and tracing of items in logistics operations over a wide geographical area. 5G connection is expected to improve the effectiveness of information exchange among supply chain partners and eliminate logistics problems such as losing cargo, the misplacement of container, or inability to identify the party/person responsible for damage (Togard, 2017). For example, Que, Chen, Chen and Jiang (2016) propose the 5G connection in food supply chains in order to ensure food safety through the dynamic information acquisition. Likewise, to increase safety and efficiency of operations, the connected port project in the Port of Livorno aims to digitalize port operations with 5G connection to ensure smart, safe, efficient, and instant information flow among shipping companies, coastguards, police, and the transport authorities (Ericsson, 2016).

9.2.8 Autonomous Vehicles

The use of autonomous vehicles in logistics operations enables the identification of the shortest and fastest haul routes, increases vehicle utilization rates, decreases the number of empty trips, enhances operational effectiveness (Flämig, 2016; James & Lam, 2018), reduces negative environmental impact (Bechtsis, Tsolakis, Vlachos, & Srai, 2018) and improves safety (DHL, 2014). The use of autonomously guided transportations systems in-house logistics operations dates back to 1960s (Flämig, 2016). Currently, autonomous vehicles are used in many warehousing activities such as picking, loading, transport, and palletizing due to their ability to work in tight spaces, adapt to changing conditions, determine the optimal route, and change the route if they encounter obstacles (DHL, 2014). Autonomous vehicles are also used in outdoor logistics activities within the facility's controlled zone, e.g. transporting items between the container cranes and the stacking area (Flämig, 2016). As a further step, driverless vehicles will soon be used for the long-distance freight transportation in uncontrolled, public zones. Tests have proved successful, and the long-distance freight transportation with driverless vehicles is expected as soon as some safety issues and the legislative ambiguity regarding the liabilities of parties are resolved (Bowcott, 2017). In the last-mile delivery of commercial goods, some companies are planning to use drones in the near-future (e.g. Amazon Prime Air). There are also some existing projects aiming to develop unmanned maritime transport (Flämig, 2016).

9.3 Research Method

How the above-mentioned Industry 4.0 enabling technologies relate to each other is not easy to understand. In these circumstances, the interpretative structural modeling (Warfield, 1974) is a valuable computer-assisted tool developed to aid understanding of complex structures. This method takes into account indirect effects among many variables, and therefore provides a richer understanding on the phenomenon. Based on the expert opinions, this method is able to reveal the hierarchical structure by identifying driving, linkage, and dependent variables. Many studies have benefited from the interpretative structure modeling to shed light on various topics in the field of logistics, such as the selection of the third-party logistics provider (Govindan, Palaniappan, Zhu, & Kannan, 2012), motivations of implementing reverse logistics activities (Sorkun, 2018b), and big data enablers for operations and supply chain management (Lamba & Singh, 2018). Nevertheless, the interpretative structural model has been criticized due to its modeling effects with only binary values 0 (no influence) and 1 (there is influence) without considering their strength. In order to overcome this limitation, Khatwani, Singh, Trivedi, and Chauhan (2015) propose a Fuzzy-Total Interpretative Structural Modeling (Fuzzy-TISM) that uses fuzzy numbers to indicate the strength of influences. The details and steps of the Fuzzy-TISM model will be depicted in the following application section.

The input of the Fuzzy-TISM model is expert opinion of the strength of influence for each variable pair (i.e. very high, high, low, very low, and no influence). To find the suitably qualified experts, the plant manager of an automotive supplier company in Turkey was contacted, because this company's smart plant is one of few in Turkey, which is designed to carry out Industry 4.0 applications. This automotive supplier company, one of the leading companies of the battery industry in Turkey, is the newly established joint venture between Turkish and Japanese giant companies. This joint venture (automotive supplier) company is currently exporting its products (automotive and industrial batteries) to four different continents from its production facilities located in the Turkish city of Manisa, which have an annual production capacity in excess of million units.

After some field observations, the plant manager and IT manager of the automotive supplier company were interviewed to identify the technologic enablers of the Industry 4.0 applications used in logistics operations. In these interviews, the appropriateness of the nine of Industry 4.0 technologic enablers proposed by Rüßmann et al. (2015)—big data analytics, autonomous robots, simulation, the industrial internet of things, cloud computing, cybersecurity, the additive manufacturing, and augmented reality—was discussed. After these interviews and some email correspondences, some changes were made to the list of enablers. It was decided to exclude 'cybersecurity' from the analysis because of its obvious importance for all digital operations. Simulation was also excluded, because it was a subset of another variable, 'big data analytics'. 'Systems integration' was excluded, as being too general. Also, in order to adapt the technologic enablers to logistics operations, the variable 'autonomous robots' was replaced with 'autonomous vehicles'. Finally, '5G connection' was included into the analysis due its importance and recent popularity. Following these decisions, the eight technologic enablers below were considered in the analysis:

T_1: Big Data Analytics (BDA)
T_2: Internet of Things (IoT)
T_3: Artificial Intelligence (AI)
T_4: Cloud Technology (CT)
T_5: Augmented Reality (AR)
T_6: 3D Printing (3DP)
T_7: The Fifth Generation Mobile and Wireless Communications (5G)
T_8: Autonomous Vehicles (AV)

During interviews, it was discovered that a giant German company is giving consultancy to many Turkish manufacturers (including the above-mentioned automotive supplier company) for their successful adoption of Industry 4.0. The expert stated that one purpose of this consulting service is that the German company, which has plants in five different cities in Turkey, is aiming to build an Industry 4.0 ecosystem in Turkey to leverage its own Industry 4.0 applications. After learning about this important mission, the German company's project manager was contacted, who agreed to give an interview and participate in the Fuzzy-TISM application. Subsequently, a two-hour meeting was held with the German company's project manager and the automotive supplier company's IT manager, in which the relationships among the eight technologic enablers were discussed pair-wise, considering their uses in logistics operations.

9.4 The Application of Fuzzy-TISM

For the pairwise comparison between any two variables, the four symbols used for coding are as below:

V—The variable on the y-axis influences the variable on the x-axis.
A—The variable on the x-axis influences the variable on the y-axis.
X—The variable on the x-axis and the variable on the y-axis influence each other.
O—No influence between the variable on the x-axis and the variable on the y-axis.

In addition to the direction of influence, the following five linguistic terms are used to determine the strength of influence: very high (VH), high (H), low (L), very low (VL), and no influence (No). For example, the symbol 'V (VH)' shows that the variable on the y-axis influences the variable on the x-axis, and the strength of this influence is 'very high'. Alternatively, the symbol 'X (H, L)' indicates that the influence from the variable on the y-axis to the variable on the x-axis is 'high', while the influence from the variable on the x-axis to the variable on the y-axis is 'low'. If one symbol is used in the parenthesis with the symbol 'X' (e.g. 'X (VL)'), it indicates that the influence between two variables on both directions is same (i.e. 'very low'). As a final example, the symbol 'O (No)' indicates no existence of influence between variables.

The responses of participants were coded using the symbols depicted above. Accordingly, Tables 9.1 and 9.2 show below the structural self-interaction matrix and the fuzzy reachability matrix respectively.

Table 9.1 Structural self-interaction matrix

	T_8	T_7	T_6	T_5	T_4	T_3	T_2
T_1	X(VH)	A(H)	V(L)	V(H)	X(L,H)	X(VH)	V(VH)
T_2	X(VH,VH)	X(H,VH)	X(VH,VL)	X(H,VL)	X(VH,H)	V(VH)	
T_3	X(H)	A(H)	X(L,VL)	X(H,L)	X(H,L)		
T_4	X(VH)	X(VL,H)	X(L)	V(H)			
T_5	X(H,VL)	X(VL)	X(L)				
T_6	O(No)	A(H)					
T_7	X(H)						

T_1: BDA; T_2: IoT; T_3: AI; T_4: CT; T_5: AR; T_6: 3DP; T_7: 5G; T_8: AV

Table 9.2 Fuzzy reachability matrix

	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
T_1		VH	VH	L	H	L	No	VH
T_2	No		VH	VH	H	VH	H	VH
T_3	VH	No		H	H	L	No	H
T_4	H	H	L		No	L	VL	VH
T_5	No	VL	L	H		L	VL	H
T_6	No	VL	VL	L	L		No	No
T_7	H	VH	H	H	VL	H		H
T_8	VH	VH	H	VH	VL	No	H	

T_1: BDA; T_2: IoT; T_3: AI; T_4: CT; T_5: AR; T_6: 3DP; T_7: 5G; T_8: AV

The fuzzy sets (Zadeh, 1965) allow elements to belong to sets partially with a membership value between 0 (not a member of set) and 1 (a member of set). This property is very useful, when decision makers have difficulty in quantifying the magnitudes of influences between variables (Chou & Liang, 2001). In this respect, the triangular fuzzy sets are commonly used to determine a membership function for linguistic terms. The use of three parameters (i.e. lower limit, upper limit, and a likely value between these two limits) in defining a membership value for each element (linguistic term) can provide a good approximation (Nauck, 2003). Following the work of Khatwani et al. (2015), this study used the following fuzzy triangular values to replace the linguistics terms:

Very High Influence (VH):	(0.75, 1.00, 1.00)
High Influence (H):	(0.50, 0.75, 1.00)
Low Influence (L):	(0.25, 0.50, 0.75)
Very Low Influence (VL):	(0.00, 0.25, 0.50)
No Influence (No):	(0.00, 0.00, 0.25)

Below, the final fuzzy reachability matrix (Table 9.3) is shown with the fuzzy triangular values. Table 9.3 also shows dependence and driving power scores for each variable, which were computed via the defuzzification method of Opricovic and Tzeng (2003).

Although the fuzzy linguistic terms are more appropriate to indicate the influences between variables, they cannot be used to set the variables' hierarchical levels. Hence, the fuzzy linguistic terms in the fuzzy reachability matrix (Table 9.2) were defuzzified to determining hierarchical levels. The defuzzification was made by coding the linguistic term 'very high influence (VH)' as 1, and rest (No, VL, L, and H) as 0. Table 9.4 shows the defuzzified reachability matrix that also contains the transitive links (i.e. indirect effects between variables).

Finally, in order to determine the hierarchical position of each variable, the defuzzified reachability matrix was partitioned. Initially, the reachability and antecedent sets of all variables were found using the defuzzified reachability matrix (Table 9.4). The hierarchical level was set for variables whose reachability set and the intersection of their reachability and antecedent sets were found identical. In the next (second) iteration, the variables whose hierarchical levels were set in the previous (first) iteration were excluded from the analysis, and then the same procedure was applied to the remaining variables. In two iterations, the hierarchical levels of all variables could be identified in this study as shown in Table 9.5.

9.5 Findings

The results show that the relationships between the Industry 4.0 enabling technologies used in logistics operations can be represented by two hierarchical levels. As seen in Fig. 9.1, augmented reality and 3D printing are at the top of hierarchy. The other six technologies—big data analytics, internet of things, artificial intelligence,

Table 9.3 Fuzzy and crisp values of driving power and dependence of criteria

	T_1			T_2			T_3			T_4			T_5			T_6			T_7			T_8			**			#
T_1	1.00	1.00	1.00	0.75	1.00	1.00	0.75	1.00	1.00	0.25	0.50	0.75	0.50	0.75	1.00	0.25	0.50	0.75	0.00	0.00	0.25	0.75	1.00	1.00	4.25	5.75	6.75	5.0417
T_2	0.00	0.00	0.25	1.00	1.00	1.00	0.75	1.00	1.00	0.75	1.00	1.00	0.50	0.75	1.00	0.75	1.00	1.00	0.50	0.75	1.00	0.75	1.00	1.00	5.00	6.50	7.25	5.8065
T_3	0.75	1.00	1.00	0.00	0.00	0.25	1.00	1.00	1.00	0.50	0.75	1.00	0.50	0.75	1.00	0.25	0.50	0.75	0.00	0.00	0.25	0.50	0.75	1.00	3.50	4.75	6.25	4.1502
T_4	0.50	0.75	1.00	0.50	0.75	1.00	0.25	0.50	0.75	1.00	1.00	1.00	0.00	0.00	0.25	0.25	0.50	0.75	0.00	0.25	0.50	0.75	1.00	1.00	3.25	4.75	6.25	4.1000
T_5	0.00	0.00	0.25	0.00	0.25	0.50	0.25	0.50	0.75	0.50	0.75	1.00	1.00	1.00	1.00	0.25	0.50	0.75	0.00	0.25	0.50	0.50	0.75	1.00	2.50	4.00	5.75	3.4790
T_6	0.00	0.00	0.25	0.00	0.25	0.50	0.00	0.25	0.50	0.25	0.50	0.75	0.25	0.50	0.75	1.00	1.00	1.00	0.00	0.00	0.25	0.00	0.00	0.25	1.50	2.50	4.25	2.3463
T_7	0.50	0.75	1.00	0.75	1.00	1.00	0.50	0.75	1.00	0.50	0.75	1.00	0.00	0.25	0.50	0.50	0.75	1.00	1.00	1.00	1.00	0.50	0.75	1.00	4.25	6.00	7.50	5.0522
T_8	0.75	1.00	1.00	0.75	1.00	1.00	0.50	0.75	1.00	0.75	1.00	1.00	0.00	0.25	0.50	0.00	0.00	0.25	0.50	0.75	1.00	1.00	1.00	1.00	4.25	5.75	6.75	5.0417
*	3.50	4.50	5.75	3.75	5.25	6.25	4.00	5.75	7.00	4.50	6.25	7.50	2.75	4.25	6.00	3.25	4.75	6.25	2.00	3.00	4.75	4.75	6.25	7.25				
#	4.5615			5.1266			5.5890			6.0580			4.3359			4.7500			3.2300			6.0814						

*Dependence; **Driving power; # Crisp value

Table 9.4 Defuzzified reachability matrix with fuzzy linguistic terms

	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
T_1	1	1	1	**1**	0	**1**	**1**	1
T_2	**1**	1	1	1	0	1	**1**	1
T_3	1	**1**	1	**1**	0	**1**	**1**	**1**
T_4	**1**	**1**	**1**	1	0	**1**	1	1
T_5	0	0	0	0	1	0	0	0
T_6	0	0	0	0	0	1	0	0
T_7	**1**	1	**1**	**1**	0	**1**	1	**1**
T_8	1	1	**1**	1	0	**1**	**1**	1

Very High Influence (VH) is coded 1 and rest is coded 0
Bold numbers indicate transitive links

Table 9.5 Final fuzzy reachability matrix partition

Variable	Reachability	Antecedent	Intersection	Level
First iteration				
T_1	T_1, T_2, T_3, T_4, T_6, T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	
T_2	T_1, T_2, T_3, T_4, T_6, T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	
T_3	T_1, T_2, T_3, T_4, T_6, T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	
T_4	T_1, T_2, T_3, T_4, T_6, T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	
T_5	T_5	T_5	T_5	I
T_6	T_6	T_6	T_6	I
T_7	T_1, T_2, T_3, T_4, T_6, T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	
T_8	T_1, T_2, T_3, T_4, T_6, T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	
Second iteration				
T_1	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	II
T_2	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	II
T_3	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	II
T_4	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	II
T_7	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	II
T_8	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	T_1, T_2, T_3, T_4,T_7, T_8	II

cloud technology 5G connection, autonomous vehicles—, at the bottom of hierarchy, have strong influence on each other either directly or indirectly. These six technologies also have varying degrees of influence on 3D printing and augmented reality. The findings show that big data analytics, internet of things, augmented reality, and cloud technology strongly influence the augmented reality, while internet of things and 5G connection strongly influence the 3D printing technology. Below, Fig. 9.1 shows the hierarchical Fuzzy-TISM diagraph that illustrates the strength of influence for each pair of the enabling technologies examined.

Figure 9.2 shows the driving power and dependence scores for each enabling technology. The findings demonstrate that no enabling technology is positioned in the lower-left quadrant of the graph, implying that none of the technologies is autonomous (i.e. neither needs other technologies nor needed by others). The figure

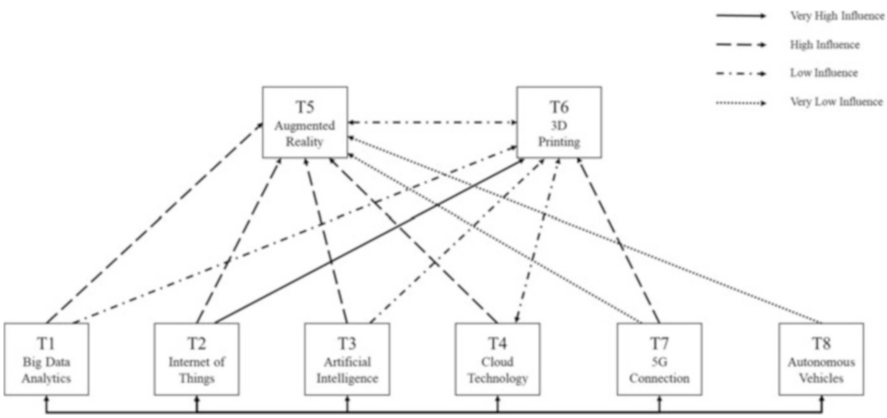

Fig. 9.1 The hierarchical Fuzzy-TISM diagraph

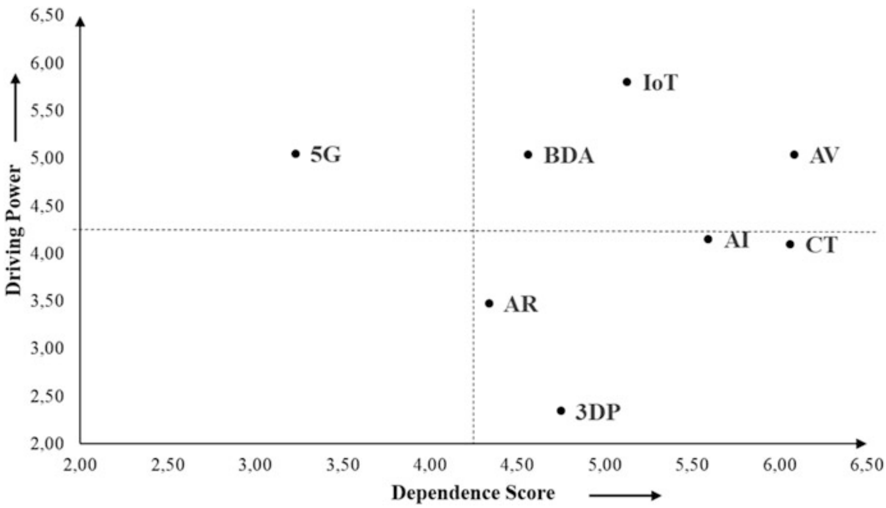

Fig. 9.2 Driving power and dependence matrix based on fuzzy reachability matrix

also shows that the only technology positioned in the upper-left quadrant is 5G connection, indicating that 5G is a driving (independent) technology in Industry 4.0 logistics operations, and is key for other technologies; however 5G itself has no need of these technologies. In contrast, augment reality and 3D printing technologies are in the lower-right quadrant, showing that they are dependent on other technologies, but others are not substantially dependent on augmented reality or 3D printing. The remaining technologies (i.e. big data analytics, internet of things, artificial intelligence, cloud technology, and autonomous vehicles) positioned around the upper-right quadrant can be called as linkage technologies, with both high driving power and dependence scores.

9.6 Conclusion

The current economic wealth of developed countries can be attributed to their ability to adapt to previous three industrial revolutions in a timely and successful way (Morrar, Arman, & Mousa, 2017). Since revolutions radically change the existing success parameters by invalidating the know-how of existing practices, they present a clear opportunity for relatively weaker players to challenge for a stronger position by adapting more effectively to the rules of new game. In this regard, the fourth industrial revolution provides a great opportunity for firms in developing countries to increase their competitiveness in the global market through rapid adaptation. The leading firms also have to achieve a smooth adaptation to the Industry 4.0 era to maintain their strong positions in the global market. If they fail to transfer new technologies into their profitable mainstream operations, new players may disrupt them (Li, Hou, & Wu, 2017).

Industry 4.0 puts emphasis on mass customization that requires both efficiency and flexibility. However, efficiency and flexibility are two conflicting supply chain strategies in a traditional production system (Sorkun & Onay, 2016). Improving both efficiency and flexibility is possible only if the integration and synchronization along the whole supply chain can be provided through the effective use of data in logistics operations (Gunasekaran et al., 2017; Srinivasan & Swink, 2018). Hence, digitalization and logistics are two important keywords at the outset of the Industry 4.0 era. Regarding the significance of achieving digital transformation in logistics operations, this study investigates the key Industry 4.0 enabling technologies and their interrelationships, considering their use in logistics operations. At this point, this study makes two important contributions. First, it gives a detailed information on the eight buzzwords discussed in the discourse of Industry 4.0, and explains their possible contributions to the effectiveness of logistics operations. Second, by identifying driving, dependent, and linkage technologies, this study helps clarifying the confusion on how these buzzwords (i.e. technologies) relate to each other. Since such contribution provides a clear road map, firms will have an enhanced understanding of the technology to prioritize, given their limited resources and funds. They will also be able to visualize the logistics digitalization process one step at a time, allowing more effective planning. In addition, the results give firms the ability of understanding which technologies are complementary, i.e. enabling them to derive maximum benefit from one technology by adopting another.

Fast, reliable, and low-latent connection has utmost importance in logistics operations because of their being carried out on a geographically wide area. For example, the inventory ordering decision might vary depending on the condition of goods being transported in a very remote area. Therefore, the geographically scattered entities in supply chain should be seamlessly connected, and have access to the most recent data to optimize logistics operations. In particular, technologies such as augmented reality and autonomous vehicles cannot be used in logistics operations without ensuring a high speed, reliable, and secure connection. For this reason, as results demonstrate, 5G connection is emerging as the main driver of the digitalization process in logistics operations. The results also indicate that internet of things, big data analytics, artificial intelligence, and cloud technology are complementary enabling technologies essential for improving logistics operations, due to their role in effective data management, which is highly important for firms in the Industry 4.0 era. Internet of things contributes to the creation of big data, which can efficiently be stored only in the cloud. Big data analytics, including the artificial intelligence techniques, are able to process this big data in the cloud, and then convert it to the form that managers can use to gain insights for their decision-making. The physical objects can also access the processed data in the cloud for determining their best course of actions, and can exchange it with other entities via the internet of things technologies.

The other three enabling technologies—artificial intelligence, 3D printing, and autonomous vehicles—increase the efficiency and effectiveness in logistics operations by exploiting information produced by the collaborative efforts of internet of things, big data analytics, artificial intelligence, and cloud technology. However, these three enabling technologies are not wholly dependent technologies, since they also return their activity data, which further feeds big data, improving its veracity, variety, and velocity. In logistics activities, in particular data from autonomous vehicles may be used more intensively than 3D printers and augmented reality devices. This may explain why autonomous vehicles technology was not found at the top of hierarchy in Fig. 9.1, and in the lower-right quadrant in Fig. 9.2, unlike the technologies of augmented reality and 3D printing.

The results provide some implications for policy makers. Advanced countries already recognize the importance of industrial digitalization, shown by the national and even transnational programs, such as 'A Digital Agenda for Europe - A Europe 2020 Initiative', 'the Big Data Research and Development Program' in USA, and 'Big Data Initiative' in South Korea (Zhong, Newman, Huang, & Lan, 2016). It is also urgent for developing countries to take the necessary steps to complete the digitalization process for leveraging the competitiveness of their firms. Specific to logistics operations, the results highlight that the policy-makers should primarily focus on building the 5G-connection infrastructure to pave the way for Industry 4.0 logistics applications. Second, with digitalization, the necessity of storing and processing large amount of data in the cloud raises concerns about cybersecurity. Policy-makers should make the legislation strong enough to deter the possible malware attacks on firms' confidential data. Similarly, legislative regulation is also necessary for clarifying various parties' liabilities regarding autonomous vehicles. Without these measures, the digitalization process could be slowed due to security and legislative concerns.

The results also provide useful managerial implications. To begin with, firms should unite to increase their lobbying efforts for the timely completion of the 5G network infrastructure in their countries. This is especially important for logistics operations because of their being carried out on a geographically wide area. Second, firms should ensure that all work tasks and equipment along supply chain (e.g. vehicles, machines goods, and pallets) are provided with RFID tags or other internet of things technology for their real-time traceability and performance measurability. This enables both the collection of sufficiently large amount of data for effective data analysis and re-optimization of processes in case of any problem or changing condition. Next, firms need skilled human resources with both field (logistics) and analytic knowledge to be able to apply big data analytics, including the artificial intelligence methods (e.g. machine and deep learning), and interpret the analysis results appropriately. It is equally important for firms to find the most appropriate cloud service option. Since it is costly to build and maintain proprietary IT infrastructure, it seems more appropriate for firms to outsource the cloud service. Here, it is important to ensure that the cloud service outsourced is sufficiently customized to meet their specific needs. Also, the appropriate design of cloud service (well-defined access rights, i.e. public, private, and hybrid cloud) is essential for data security. Only after completing these important steps, should firms focus on exploiting 3D printers, augmented reality, and autonomous vehicles in order to increase the effectiveness of their logistics operations.

This study has a number of limitations that may guide future research. First, the key enabling technologies used in this study were determined based on their recent popularity across industry sectors. Future research could modify the list of technologies in accordance with the focus on their significance in logistics operations. Second, there are some challenges to generalizability, because this study collected the data from experts only in Turkey (a developing country), but to increase the generalizability of results, it would be interesting to compare the responses of experts across countries including the developed ones. In addition, this study used the opinions of a very few experts for the data analysis. To eliminate possible respondent bias risk, surveys involving a large number of experts should be used in future studies. Last, this study examined the effects of enabling technologies on logistics activities without distinguishing any particular logistics activity. In future studies, it would be useful to conduct a more micro-level analysis, examining how enabling technologies interact with respect to each particular logistics activity, e.g. transport and warehousing.

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Chapter 10
Digitalization of Business Logistics Activities and Future Directions

Ebru Beyza Bayarçelik and Hande Begüm Bumin Doyduk

Abstract Currently we are facing the last industrial revolution, industry 4.0, which enables communication between humans as well as machines in Cyber-Physical-Systems (CPS). The concept industry 4.0 was first brought up in Germany. With the promises of the concept and increasing demand in cost effectiveness, flexibility, and sustainability, industry 4.0 has drawn considerable interest globally. The industry 4.0 era will lead to breakthrough chances in the business world. As the technologies of this era enable ubiquitous presence and real time information about each single piece of a process, it has been used in many firms in developed countries for some time. It is apparent that this new era will cause significant changes in our lives. Concepts of this new era such as cyber physical systems and internet of things have already gained considerable interest. Technologies that will be used widespread in the new future offer big opportunities for cost reduction and assessment of operations. Thus, the emerging developments in technology are closely followed especially by the logistics sector. Industry 4.0 involves numerous technologies and related paradigms (Thames & Schaefer, 2016). In this chapter, after a brief description of digitalization and industry 4.0, some main industry 4.0 technologies used in the logistics sector will be explained. Consequently, the advantages and disadvantages, and the possible opportunities and threats for the logistics sector will be discussed. Finally the current situation of logistics firms all over the world and specifically in Turkey will be discussed.

10.1 Introduction

The industrial revolution started with the introduction of water- and steam-powered mechanical manufacturing at the end of the eighteenth century, named as industry 1.0. The division of labor at the beginning of the twentieth century, use of electricity,

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and mass production characterize the industry 2.0. In addition, during the 1970's wide spread computerization and introduction of programmable logic controllers (PLC) for automation started the industry 3.0 era. Recently we are facing the last industrial revolution, industry 4.0, which enables communication between humans as well as machines in Cyber-Physical-Systems (CPS). Industry 4.0, came into view in official documents and foreshadowed an industrial revolution (MacDougall, 2014). For aging population countries like Northern European countries, the US and Japan, industry 4.0 applications are crucial since this industrial revolution will enable human physical effort needs to decrease significantly (Kagermann, Wahlster, & Helbig, 2013).

10.2 Industry 4.0 Around the World

The industry 4.0 concept stems from Germany, notwithstanding it has gained considerable attention from all over the world. The German government positioned industry as a national strategic initiative in 2011. The main purpose of this initiative is to encourage digital production through internet of things and value chain and business models (Commission, 2017). After 2011, this concept spread globally and became a main subject line as of 2016 in the World Economic Forum (Forum, 2016a). In 2012, the German government enacted the action plan of 'High-Tech Strategy 2020' and budgeted billions of euros for the forefront technology developments. Industry 4.0 is one of the ten projects stated in 'High-Tech Strategy 2020' (Kagermann et al., 2013). In 2013 the French government introduced 'La Nouvelle France Industrielle' which is a strategic review defining industrial policy priorities and initiatives (CNI, 2017). In 2014 the European Commission initiated Public-Private Partnership (PPP) on 'Factories of the Future (FoF)'. FoF is incorporated in 'Horizon 2020'. Through 'Horizon 2020', FoF has access to 80 billion euros of funding (European Commission, 2016).

In 2013, the United Kingdom (UK) government introduced 'Future of Manufacturing, a depiction of the manufacturing industry till year 2050, with the intention of administrating UK manufacturing growth supporting policies' (Foresight, 2013). In order to be ready to lead the next era of manufacturing, the United States (US) government has been focusing on national discussions, activities and recommendations, named 'Advanced Manufacturing Partnership' (AMP) (Rafael, Shirley, & Liveris, 2014). Also the industrial internet consortium (ICC) endorsed industry 4.0 substance (Stock & Seliger, 2016). The conjuncture is not very different in Asia. The South Korean government presented 'Innovation in Manufacturing 3.0' in which four advancement strategies and responsibility areas were stated (Kang et al., 2016). In 2015, the Chinese government launched the 'Made in China 2025' strategy and 'Internet Plus' plan. In order to fasten industrialization and digitalization in manufacturing sector, ten different areas were focused (Li, 2015). Also in 2015, the Japanese government approved the fifth Science and Technology Basic Plan, in order to reach the target of being a world-leading 'Super Smart Society'

(Office, 2015). In 2016, \$19 billion was allocated to the Research, Innovation and Enterprise 2020 Plan by the Singapore government (Foundation, 2016).

It took 120 years for the spinning machine to spread all over the world from Europe. However, it took only 15 years to diffuse internet technology. Consequently, the industry 4.0 applications are expected to diffuse very fast (Schwab, 2018). The industry 4.0 has captured great attention in developing countries including Turkey.

It is suggested that the current status of industry in Turkey can be positioned as somewhere between industry 2.0 and Industry 3.0 (Yıldız, 2018). The main drawback of the industrial revolution in Turkey can be summarized as not having the required technological infrastructure for factory automation and control of whole production processes (EKOIQ, 2014; TOBB, 2016). Turkey's high technology exports is around 4%, while it is 30% in South Korea and 15% in the EU (Ege Bölgesi Sanayi Odası, 2015). The announced goals of R&D investments by the Scientific and Technological Research Council of Turkey (TUBITAK) was 3% of the GDP; however, the actual percentage is less than 1% (Çeliktaş, Sonlu, Özgel, & Atalay, 2015). Yıldız (2018) proposed that this situation should be corrected by firstly ameliorating the education system and including industry 4.0 related skill trainings, such as data analysis and software development, during high school years (Yıldız, 2018).

The Turkish Industry and Business Association (TUSIAD) and Boston Consulting Group conducted a study on the awareness of Industry 4.0. According to the study, some of the projects that have been used are integrated quality management, integrated design data, horizontal data integration, artificial factory and product design, flexible production, automated guided vehicles and self-optimizing process flow. It is forecasted that 10–15 billion TL annual investment for a 10 year period is needed to enable industry 4.0 technologies to be adapted to the production process. In case of successful implementation of industry 4.0 technologies, a 5–15% of productivity increase is expected (TUSIAD, 2016).

Mrugalska and Wyrwicka (2017) defined industry 4.0 as the integration of complex physical tools and machines to network, sensors and software for the purpose of forecasting, controlling and planning trade and societal outcomes (Mrugalska & Wyrwicka, 2017). According to Hermann, Pentek, and Otto (2016), industry 4.0 can be analyzed under four main components; cyber physical systems, internet of things, internet of services and smart factories (Hermann et al., 2016). Industry 4.0 involves numerous technologies and related paradigms (Thames & Schaefer, 2016). Some of these paradigms are; radio frequency identification (RFID), enterprise resource planning (ERP), internet of things (IoT), Cyber Physical Systems, cloud based manufacturing, and smart factories (Kagnicioglu & Ozdemir, 2017; Lu, 2017; Yıldız, 2018). Some of these paradigms are summarized below.

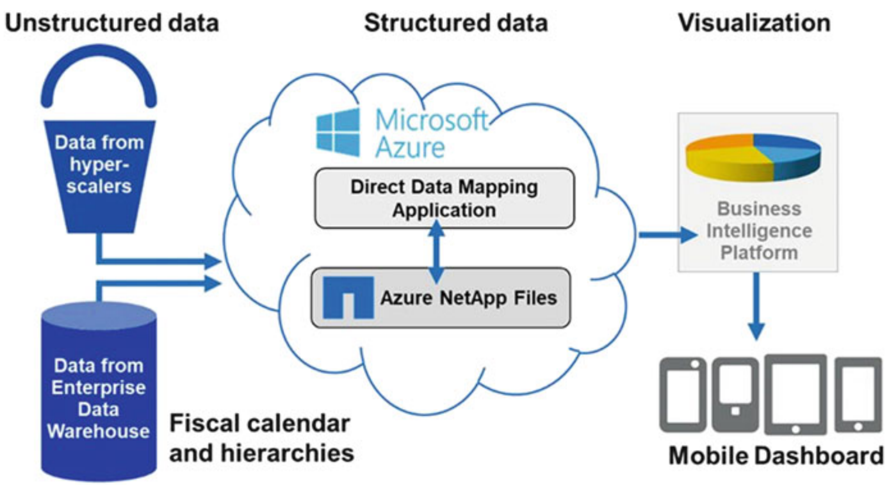


Fig. 10.1 Visualization of big data (Turan, 2017)

10.2.1 Big Data

Improvement in information and communication technologies, especially after the enormous increase in internet usage such as social media, daily banking transactions and e-commerce, has enhanced the amount of generated data. Especially in 2012, big data has attracted academic researchers, business professionals and government agencies in order to gain a competitive advantage (Reddig, Dikunow, & Krzykowska, 2018). In recent years, the term "Big data" is used to refer to very large volumes of data sets that are too difficult to store and manipulate with traditional data tools and software techniques (Turan, 2017). These data is collected from many different sources like; sensors, cameras, network devices, social media, web sites and e-mail services (see Fig. 10.1).

Big data explains the large amount and variety of fast-moving information that require new management and processing methods so as to enable enhanced decision making, forecasting, business analysis, customer experience and loyalty to create significant value (Casado & Younas, 2014; ENISA, 2016). The main characteristics of big data are the prism of 'three Vs model' volume, velocity and variety. Later some researchers and businesses developed new features as veracity and variability (Heemskerk, Young, Takes, & Cronin, 2018).

- ***Volume*** refers to the amount of the data, which is processed. Data have grown to a limitless size that prevents analysis with traditional tools. Data volume increases every day at a rate of 2.5 Exabyte or 2.5 billion gigabytes.
- ***Variety*** refers to the range of structured and unstructured data types. That is, the different sources of information and the different data schemas of each source, for example, social media post, tweets, location data from navigation, call center records, video, speech, text messages and sensor dates and more.

- ***Velocity*** refers to the frequency of the data generation that needs to be processed in real or near-real time in order to be of greatest value. Organizations are analyzing millions of trading events per day to identify security threats.
- ***Veracity*** refers to the fact that the quality of data is often unclear. Therefore, veracity deals with the description of the origin, creation and propagation process of data and concerns about accuracy and completeness.
- ***Variability*** refers to use of data, required to understand how the data are constructed because data meaning is often changing, and the data can show inconsistency at times, and this can hamper the process of handling and managing the data effectively (Casado & Younas, 2014).

The data is increasingly digitalized and turned to huge data which is processed through the use of cloud computing technologies and infrastructures. Data are collected from different resources and are used by many industries such as health, security, energy, banking, army, education and logistics. Therefore, data are the most important input for IoT, robotics, digital twins, smart factories, artificial intelligence and augmented reality of innovative services in Industry 4.0. Then what type of data does Industry 4.0 require? It depends on the service needs, such as; maintenance intervals, critical component descriptions data from industrial equipment; hardware location; GPRS, RFD data for geospatial and data from sensors such as temperatures, pressure, flow-rates and vibration. Sensors and automation systems are key components of Industry 4.0 programs. They collect very important time series through differentiated enterprises. Those time series data provide users and providers with the ability to diagnose problems that occur, and take action before any big problems appear in the systems.

10.2.2 Cloud

The collection of interconnected computers that consists of more than one united configurable computing resource is known as the "Cloud" (Arunarani, Manjula, & Sugumaran, 2019). Cloud has become a favoured technology, which attracts both organizations and users in the global world. Although cloud computing is much older, it has developed more prominently after the 2000's, especially after Web 2.0 and the social media. The concept of cloud computing, which has become a focus of attention for different technological and institutional reasons and has numerous service and installation models, has emerged from a metaphor for the internet.

The National Institute of Standards and Technology (NIST) defines Cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell & Grance, 2011, p. 7).

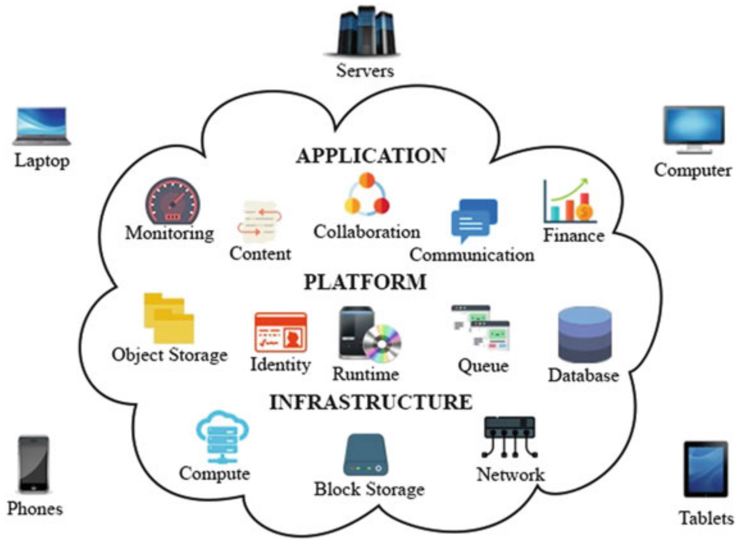


Fig. 10.2 Cloud computing (Wikipedia, 2019)

Cloud computing brings flexibility and change to the IT business. Traditionally companies had to make high capital investments in IT hardware and software infrastructure and skilled-employees, which increased the operational costs. However, Cloud computing is a next generation information management system that is based on virtual services. It allows access to a shared pool of computing resources in inter-connected data centers for cloud users in an on-demand or pay-per-use manner (Fig. 10.2) (Arunarani et al., 2019). Furthermore, Cloud Computing provides security infrastructure capabilities to enable firms to plan and implement their investment plans and business processes more easily. In addition, the cloud computing services provide redundancy, service quality and the SLA services that offer several benefits to companies in terms of business continuity and competitive advantage. As a result companies increase their productivity by using cloud accessibility features to connect to the resources of the company from anywhere at any time.

Cloud computing basic characteristics that differentiate it from other information and communication technologies are:

On-demand self-service. The user or organization can unilaterally provision computing capabilities, as needed automatically without requiring human interaction with each service provider.

Broad network access: Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

Resource pooling. Cloud computing is structured to serve a multi-tenant model, with different physical and virtual resources, through an independent location to multiple users and organizations. Examples of resources include storage, processing, memory, and network bandwidth.

Rapid elasticity. Capabilities can be flexibly adjusted according to user demands in any quantity at any time.

Measured service. Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service. Resource usage can be monitored, controlled and reported, providing transparency for both the provider and consumer of the utilized service (Mell & Grance, 2011, p. 2).

Cloud computing is usually explained based on the cloud type, or on the service that it is offering. The cloud computing types are:

- public cloud
- private cloud
- hybrid cloud
- community cloud

The services that the Cloud Computing is offering are:

- IaaS (Infrastructure-as-a-Service)
- PaaS (Platform-as-a-Service)
- SaaS (Software-as-a-Service)
- Storage, Database, Information, Process, Application, Integration, Security, Management, Testing-as-a-service and so on.

All over, the Fourth Industrial Revolution will be driven by the integration of resources and new technology. Cloud computing is also one of the essential enablers of industry 4.0 to manage and integrate platforms capable of merging automation, robotics, and Internet of Things, which contribute to innovative developments in the long run. General Electric is one of the multinational companies that uses cloud platform technology, which is a secure way for the company to store, process and analyze data from their industrial devices. The company optimizes business processes, enables a more efficient supply chain and provides predictive maintenance by using the cloud platform (Labs, 2019). On the other hand, the Oracle report revealed that 60% of the 1200 technology decision-makers surveyed across EMEA in midsize and large companies, believe that an integrated approach to cloud will unlock the potential of disruptive technologies, particularly in areas such as robotics and artificial intelligence (Allen, 2018).

10.2.3 Cloud Based Manufacturing (CBM)

Cloud based Manufacturing (CBM) is another emerging and transformative paradigm that will make a significant contribution by achieving required business flexibility in the success of industry 4.0. Cloud computing supplies adjustable and flexible supports for service-oriented production models by decreasing management and operational investment costs. Organizations capture the opportunity and adopt Cloud into the manufacturing industry to develop current production performance.

Cloud based Manufacturing is "a form of computing and service-oriented manufacturing model developed from existing advanced manufacturing models (e.g., application service providers, agile manufacturing, networked manufacturing, manufacturing grids) and enterprise information technologies under the support of cloud computing, the Internet of things (IoT), virtualization and service-oriented technologies, and advanced computing technologies" (Li et al., 2010). CBM utilizes on-demand access to share diversified and distributed production resources to create temporary, reconfigurable cyber-physical production lines, which increase productivity, reduce product life costs and allow optimum resource allocation in response to customer generated wants and needs. In brief scalability, agility, ubiquitous access, multi-tenancy and virtualization, big data, IoT and cyber physical services are basic qualifications of cloud manufacturing systems (Thames & Schaefer, 2016).

The Cloud based manufacturing system installs on Service-Oriented Architecture (SOA) in the Cloud environment that displays the infrastructure level of Cloud approaches. The basic idea of CM is "the provision of on-demand manufacturing services to end users via the Internet by coordinating distributed cloud manufacturing resources" (Lu & Xu, 2019, p. 93). Organizations and end-users could straightly connect to resource providers via application providers. Thus the cloud infrastructure can enable an optimum grouping of physical manufacturing resources for the request of the end user. On the mechanical side of cloud manufacturing, physical manufacturing assets are virtualized as virtual assets. They are all called Cloud services. Resource virtualization using a declared data model for high-level engineering management systems is utilized to make concurrent decisions. Besides, Cloud manufacturing services should be self-organizing, fault-tolerant and on-demand in order to continue without interruption. As a result, CBM instruments have characteristics such as connectedness, context-awareness, intelligence, and metric (Lu & Xu, 2019, s. 93).

10.2.4 Cyber-Physical Systems

All structures involved in the communication and coordination of physical and cyber worlds are named Cyber-Physical Systems (CPS). It is the integration of physical processes and computation (Hofmann & Rüsch, 2017). Cyber-physical systems (CPS) are a combination of physical and engineered systems, the operations of which are followed, coordinated, checked and integrated by a computing and communication core (Rajkumar, Lee, Sha, & Stankovic, 2010) (Table 10.1).

By coalescing CPS and production and logistics present factories would be turned into industry 4.0 factories (Lee, Lapira, Yang, & Kao, 2013). CPS incorporates two main parts. The first one is conducting real time data and the other one is intelligent data. From data obtaining to value creation, a workflow was proposed to demonstrate

Table 10.1 Cyber-physical systems history (Bradley & Atkins, 2015)

Year	
1932	Nyquist frequency techniques for control design
1940–1945	Theory of Sampled-Data Systems
1945	Bode: Feedback amplifier design
1946	Onset of cellular telephony
	Invention of computer Eniac
1950	Development of Root Locus Technique
1954	Emergence of digital control
1959	Development of state-space techniques
1969	ARPANET
1973	Development of real time computing
	Optimal Control, Adaptive Control
	Nonlinear Control
	Stochastic Systems
1990	Hybrid System
	Discrete Events System
1997	IEEE 812.11 Wifi Standard
1998	Development of sensing "mote", beginning of NCS
2000	Development of QoS
2002	Feedback Scheduling
	Anytime Control
2006	Cyber Physical System
2007	PCAST defines CPS as a national priority
2010	International Conference of CPS established
2012–2014	Numerous CPS Workshops held

CPS system construction (Lee, Bagheri, & Kao, A cyber-physical systems architecture for industry 4.0-based manufacturing systems, 2015). This 5C structure is made up of five levels of Smart Connection, Data-to-info Conversion, Cyber, Cognition and Configuration levels. See Figs. 10.3 and 10.4.

1. Smart Connection: Obtaining precise and reliable data from machines is the first step of the construct.
2. Data to Information Conversion: The data obtained in the first step should be converted into meaningful information. Algorithms for health management and prediction were developed.
3. Cyber Level: This level acts as the information center. Information flows from each machine to form a machine network. Special analytics are used to drive extra information and enable machines to compare themselves with the rest.
4. Cognition Level: At this level, a complete knowledge about the controlled system is created. Proper info-graphics are used to present the knowledge to the users for decision making purposes.

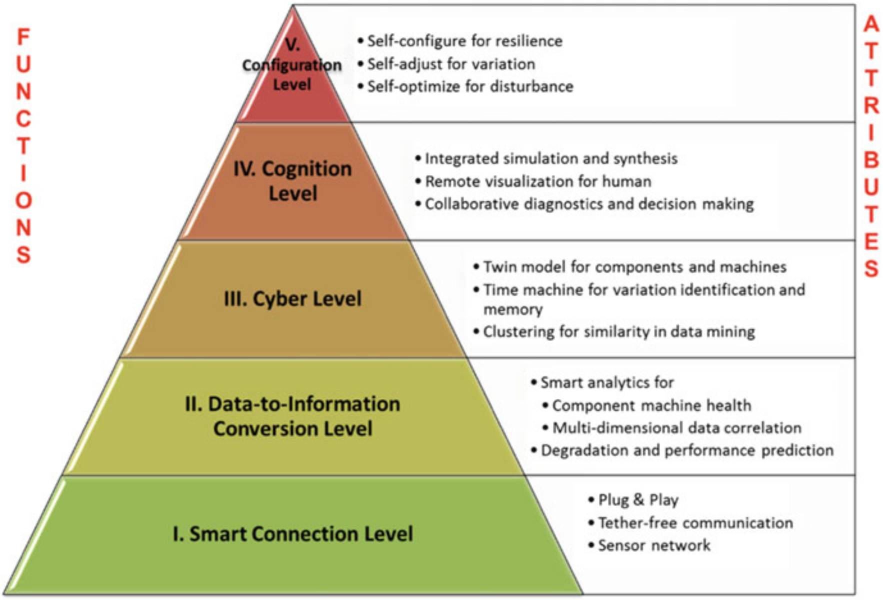


Fig. 10.3 5C Structure of CPS (Lee, Bagheri, and Kao, 2015)

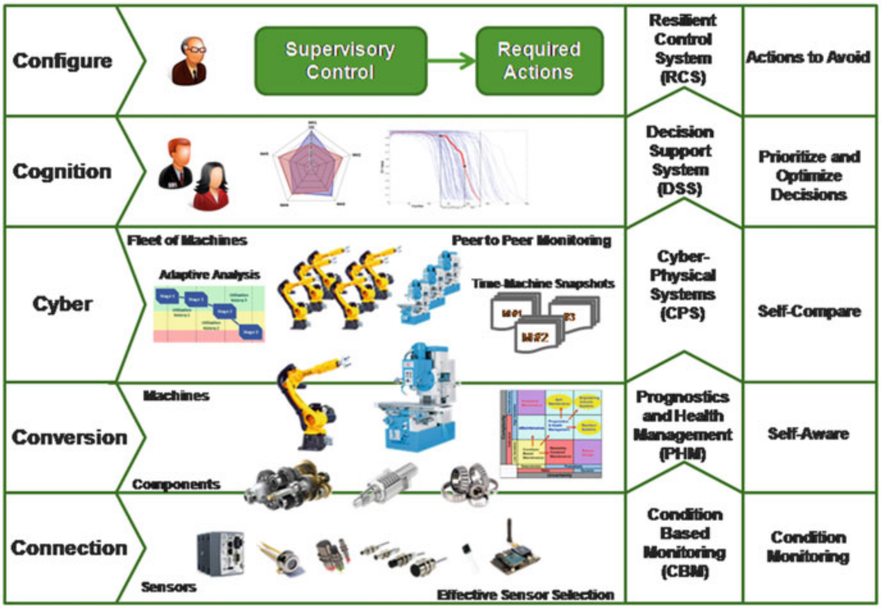


Fig. 10.4 Applications at each level of the 5C architecture (Lee et al., 2015)

5. Configuration Level: In this level assessment from cyber to physical space is made. This level works as a Resilience Control System enabling machines to self-configure and adapt.

10.2.5 Cyber Security

The fourth industrial revolution means connecting every user, provider, supplier, manufacturer, smart-machine, and overall system by cloud computing. The interconnected nature of the new environment calls for extreme importance to ensure the security of all networked systems and to prevent cyber-attacks.

Today, organizations and critical facilities are faced with much more complex, motivated and coordinated cyber-attacks and threats that can have far more extensive effects than ever before. According to 2016 Deloitte-MAPI research results, one-third of the organizations have not performed any cyber risk assessments of industrial control systems (ICS) operating on factory floors (Deloitte, 2017). However, attackers are able to bypass traditional security protection techniques by targeting systems running in organizations and critical facilities, with attack vectors such as malware and multi-layered attacks (mail, web, physical) that they have developed specifically. Also, the users can stay on the systems for too long without being noticed. As a result, the systems can be disabled at a time determined by the attackers. For this reason, it is very crucial for companies to develop new methods to ensure the security against cyber-attacks. These methods should not be in the form of applying general solutions to the company, but rather to develop and implement methods according to the business processes and infrastructures of the organization and the facility. For this purpose, the organization should design layers of cyber defense against the attack, which may come from both inside and outside. All security solutions in these layers must be monitored effectively 7/24 in real time. It should also be considered part of the security strategy in systems that will enable the recording and analysis of threats and security incidents that will provide capabilities for reducing potential risks. In order to achieve this, an end-to-end and layered security approach consisting of at least "Enterprise Network Infrastructure" and "Data Security Infrastructure" should be adopted by the systems.

Undoubtedly, in Industry 4.0, connecting machines and information is not only about digitalization, but also about the physical world; possible consequences of cyberattacks on production, consumer, and organization and all over product-services themselves may cause unrecoverable effects. Cyber security failures in IoT applications can cause production downtime and damage the equipment or facilities, which also leads to money losses and expenses and loss of revenue from brand damage (Waslo, Lewis, Hajj, & Carton, 2017).

10.2.6 Internet of Things (IoT)

Structures enabling the communication of physical things are named internet of things. It is seen both as a promising and destructive? technology. At the first stages, things were labelled and tracked with low cost sensor technologies such as RFID tools.

The Internet started with ARPANET (Advanced Research Projects Agency Network) as communication among limited number of devices. The evolution of internet can be summarized in four phases. Phase 1 is the transfer of information to the digital environment and digital access to information. Phase 2 is the collaborative use of information in the digital environment and start of e-trade. In phase 3, use of social media, mobile media and cloud informatics were widespread. Phase 4 is the digital connection of things to the internet (Gündüz & Daş, 2018).

The term "internet of things" was first used in a presentation about the benefits of radio-frequency identification made for Procter and Gamble by Kevin Ashton in 1999 (Ashton, 2009). The Internet of Things (IoT) is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment (Gartner, 2014). IoT enables analog world objects to be connected with other objects, communicate and ubiquitously operate without human interaction.

Decentralization and heterogeneity of IoT necessitates event driven architecture. Service oriented architecture (SOA) enables dismantling convoluted and massive systems into simple and explicit parts. Consequently SOA is accepted to be appropriate for attaining interoperability among diverse tools (Atzori, Iera, & Morabito, 2010; Da Xu, He, & Li, 2014; Hydra Middleware Project, 2010). The architecture for IoT can be analyzed under four major layers; sensing, networking, service and interface layer (Table 10.2).

A. Sensing Layer

Information among devices are realized and transferred automatically through wireless systems of sensors. An important technology for IoT is the RFID technology. With RFID technology, identified information can be transferred from a microchip to a reader through wireless communication. Since the 1980's this technology has been used in certain sectors such as logistics, manufacturing, retailing etc. (Ngai, Moon, Riggins, & Yi, 2008; Sun, 2012).

Table 10.2 Architecture for IoT (Da Xu et al., 2014)

Layers	Description
Sensing layer	Integration with current hardware (RFID, sensors, actuators) in order to realize and control the physical world and achieve data.
Networking layer	Data transfer and networking support
Service layer	Supply of services
Interface	Supply of cooperation methods to users.

B. Networking Layer

The Networking layer functions as a connection among things, enabling sharing of information. WSNs, wireless mesh networks, WLAN, etc. are heterogeneous networks used for IoT to exchange information.

C. Service Layer

The main role of the service layer is defining the service specifications for middleware. Middleware technology continuously integrate services and applications. It also supports IoT with cost efficiency through reuse of hardware and software. The Service layer handles services related matters like data management, information sharing and communication. This layer also processes all service-oriented issues, including information exchange and storage, data management, search engines, and communication (Guinard, Trifa, Karnouskos, Spiess, & Savio, 2010; Miorandi, Sicari, DePellegrini, & Chlamtac, 2012). The Service layer determines application requirements.

D. Interface Layer

It is complicated to continuously connect, communicate, disconnect, and operate various things. The interface layer facilitates the connection and control of things. An interface profile (IFP) can be summarized as service standards helping the application interactions (Fig. 10.5).

Internet of things can be used in many areas such as; smart homes, smart cities, scientific study applications, informatics sector applications, energy optimization applications, daily usage applications, security applications, manufacturing applications, construction applications, public sector applications, health care applications, service provider applications, agricultural production applications, transportation applications and trade applications.

In the business world the importance and future potential of IoT related applications have been fully realized. 58% of the executives stated that IoT is very important for their strategic success.

Among many industries, manufacturing and transportation are the industries that have mostly utilized IoT applications (Fig. 10.6).

Predominantly the majority of studies in these areas concentrated on the firm and government perspectives of IoT (Gao & Bai, 2014; Haller, Karnıuskos, & Schroth, 2009; Peoples, Parr, Mcclean, Scotney, & Morrow, 2013; Weber, 2010; Zhao, Zheng, Dong, & Shao, 2013).

The research into the IoT acceptance from the consumer perspective is still in its infancy. User acceptance toward a technology is the major determinant of actual usage behavior (Yi et al., 2006). Additionally, investigation into the user acceptance of information technology (IT) has always been an important issue in information management (Bandyopadhyay & Bandyopadhyay, 2010; Luarn & Lin, 2005).

Along with diverse business-to-business applications, internet of things offers many areas of usage to the individual consumers.

Some consumer electronics are Smart TVs, connected thermostats, connected cars, connected kitchen appliances, fitness trackers, health wearables, networked

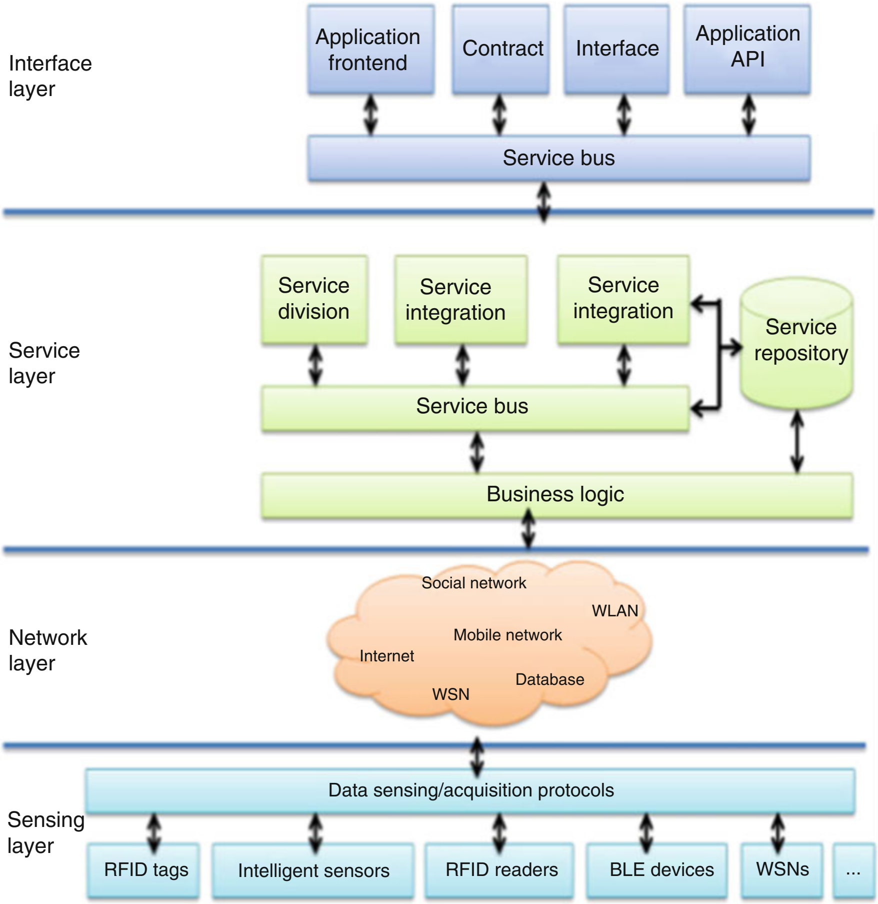


Fig. 10.5 SOA for IoT (Da Xu et al., 2014)

security cameras, connected household appliances etc. (Khan, Aalsalem, & Khan, 2018).

Some of the most popular commercialized versions are;

- micCoach smart ball; Training tool for placing kicks. The Integrated sensor package records strike point, speed, spin and trajectory when you kick the ball
- Nest smart home tools, thermostats, door bells, alarm systems etc.
- Babolat
- Edyn Smart Garden System, monitors and tracks environmental conditions.
- Belkin WeMo
- Amazon Echo
- BluesSmart
- Amazon Dash
- Jindo Bridge

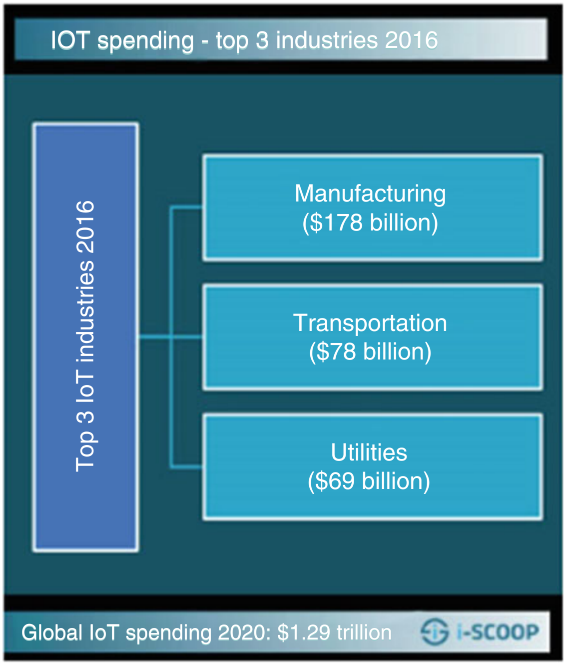


Fig. 10.6 Industries spending according to industries (IDC, 2017)

10.2.7 Artificial Intelligence and Machine Learning

Once upon a time "Artificial intelligence", was a term that was used in science-fiction movies. Today it is used as an ordinary word in the new information era. Then what is intelligence and how can we combine the terms "artificial" and "intelligence"? Intelligence is explained as "the set of mental faculties that make it possible to understand things and facts and, to discover the relationships between them in order to arrive at a rational understanding" (Iafrate, 2018). Thus, it gives possibility to understand and make changes according to the situation, which also adds new features as adaptability. Intelligence can be seen as the ability to process information to achieve objectives.

Artificial intelligence has been studied since 1931, however John McCarthy, who was the leading pioneers of AI, made the first definition in 1955 (Ertel, 2018) as:

> The goal of AI is to develop machines that behave as though they were intelligent.

Based on his definition, today Artificial intelligence (AI) is identified as "Technologies with the ability to perform tasks that would otherwise require human intelligence, such as visual perception, speech recognition, decision-making and language translation" (HM Government, 2017).

After connecting devices such as computers, watches, telephones, equipment and machines, AI has been adapted by many industries like health, insurance, banking, and army. It is wrong to think that intelligence is just specific to machines; however,

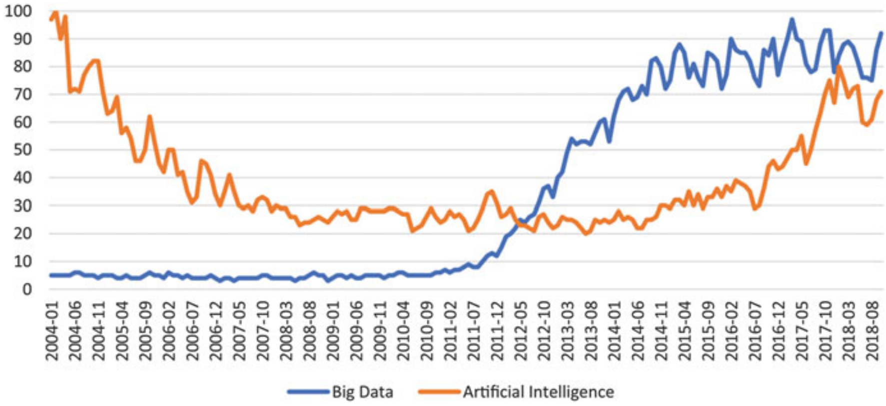


Fig. 10.7 Popularity of big data and AI from 2004 to 2018 (Google Trends, 2018) (Allam and Dhunny, 2019)

AI is the differentiation line between robotics and machine learning. There are three main components in artificial intelligence; machine or system, software and internet connectivity (cloud and big data). Robots and robotics are the most known forms of machines, which are produced in a factory and equipped with electrical circuits and smart chips for control and management. Software is the mechanism which is programmed to enable learning (machine learning). The third connecting part of AI is internet of things (IoT) which is the sensory-motor functions of machine learning.

According to the CAGR report the artificial intelligence market was 21.46 billion U.S. dollars in 2018 and they forecasted that it will be increased to 36.62% and will reach 190.61 billion U.S. dollars in 2025. Big data, cloud-based service, IoT and an increasing demand for smart virtual equipment are the main drivers for AI market growth (Global Forecast to 2025, 2019).

Although artificial intelligence has been studied since the 1955, there has not been enough application in real world. Google Trends (Fig. 10.7) analyses on the popularity of Big Data and AI exhibits a rise in Big Data from 2011 to 2014; however, a decreasing trend in AI between 2004 and 2008. After 2014, artificial intelligence awareness has started to increase as a result of helping interpret of big data (Allam & Dhunny, 2019).

Machine learning is the most crucial component of artificial intelligence that is focused on learning processes that allow a machine to evolve without its algorithms being modified. Similarly, with human learning, machines learn by first being programmed to recognize normal, then reprogrammed each time they encounter a different scenario. AI-enabled devices internalize these experiences so that they recognize when a machine is acting abnormally. Eventually, AI technology will not only be able to recognize malfunctions, but also learn what needs to be done (i.e., ordering a new part) to fix it and resolve the issue without human assistance. There are several types of learning machines: statistical, supervised (where learning rules

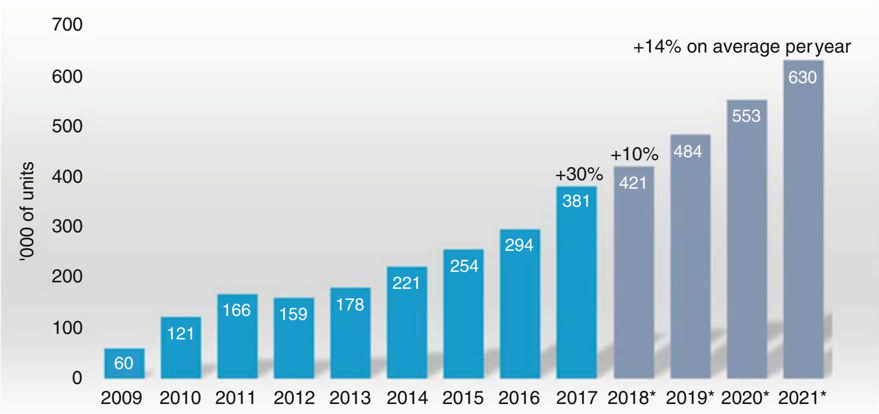


Fig. 10.8 Estimated annual world supply robot report (IFR World Robotics, 2018)

are defined from a base of examples) or unsupervised (Big Data and You: Understanding the Basics of Industry 4.0, 2018).

10.2.8 Robotics

Increases in competition and advances in technologies have led to organization investments in automation and robotics. The robot is generally defined as an automatically controlled, reprogrammable, multipurpose programmable electromechanical device that is either fixed in place or mobile for use in industrial automation applications (IFR, 2018). The fourth industrial revolution is accelerating automation. In smart factory systems, robots start to interact and communicate with other devices, materials and other production components.

The International Federation of Robotics estimates 2.1 million new automation robots will start to be used all over the world in 2021, representing an average annual growth rate of 14% between 2018 and 2021. Robotics installation rates are 10% in Europe, 13% in the U.S and 16% in Asia (IFR, 2018). The actualized and estimated annual industrial robotics production amount between 2009 and 2021 are given in Fig. 10.8.

2017 was the year in which robot sales reached the highest level in the last 5 years. Sales reached 381,335 units by expanding the market nearly 30%. For 2018, sales were estimated to increase by 10% about 421,000 units. In 2018, robot sales increased 7% in Europe, 14% in Asia. The sales; however, reduced about 4% in the Americas.

2009 was an exceptional year because of global economic and fiscal recession that caused a decrease in investment in automation and robotic technology as seen in Fig. 10.8. Between 2005 and 2008, the average annual number of robots sold was about 115,000 units. After 2010, the demand for industrial robots continued to grow exponentially. Between 2012 and 2017, the average growth in robot sales was 19% per annum. This incremental increase in robot assembling had never been so powerful before.

Between 2011 and 2017, the average annual robot sales were about 236,000 units which is double compared to the previous year's sales. From 2015 to 2017, the average annual robot supplies was about 310,000 units. The accelerating increase is an indication that robot and automation will be more on demand by organizations in subsequent years (IFR, 2018).

The automotive and electrical/electronics industries are the main driving forces behind the growth of industry robots. Robot supply in the automotive industry reached 22% of the market and continued to be the customer leader of industry robots with a share of 33% of the total sales in 2017. The electrical/electronics industry also increased their sales to 32% and caught the automotive industry with the same percentage in the total supply.

In the world, Asian markets are still in powerful growth with industrial robots' sales accelerating about 261,800 units with a rise of 37% in 2017. The second largest market is Europe. 66,300 robots were supplied and robot sales increased about 18%. America is the third largest market with 46,100 robots shipped to, in 2017 (IFR, 2018).

According to the 2018 Industrial Robots Annual report, 73% of the robot market is shared between five countries; China, Japan, the Republic of Korea and the United States. China is the leader of the market with 137,900 industrial robot sales with a share of 36% of the total supply in 2017. The second most important industrial robot market is Japan. Robot sales increased by 18% and reached to 45,566 units with effective force of automotive and electrical/electronics industry. In 2017, robot sales decreased? in the Republic of Korea by 4% to 39,732 units. However, since 2012 the industrial robot sales market has increased by 15% on the average, per year. The other two important industrial robot markets are the United States and Germany. In 2017, robot sales in the U.S. reached its highest point with 33,192 units which was 6% higher than the previous year. In 2017 Germany was the fifth robot market after the USA, with 21,404 units and reached 7% in/of the world (IFR, 2018).

10.2.9 Smart Factory

The Industry 4.0 revolution has been realized due to the integration of information & communication technologies with the industrial process. The new emerging technologies which were previously explained as big data, robot technologies, cloud computing, internet of things and wireless sensor networks, evolved traditional automation manufacturing systems to smart factory systems. Smart factories are "a (fully)-integrated and collaborative manufacturing system that responds in real time to meet changing demands and conditions in the factory, supply network, and customer needs" (NIST, 2014). It is based on the idea of a decentralized production system in which people, machine and resources can communicate over a social network. Smart factories can detect the business need through sensors, communicate with other production tools through internet and capture the production information from the Big Data in cloud systems (Alçın, 2016; Hofmann & Rüsch, 2017).

In Industry 4.0, there are three important features that should be considered in the implementation phase;

1. horizontal integration via value networks,
2. vertical integration and networked manufacturing systems, and.
3. end-to-end digital integration of engineering across the entire value chain.

Smart factory, mentioned as the vertical integration, is highly flexible, and reconfigurable (Wang, Wan, Di, & Zhang, 2016). The main idea in smart factory is "to leverage the industrial IoT, cloud computing and big data to integrate information technologies with automation deeply, along with the Artificial Intelligence technologies to improve the intelligence of machines and products" (Wang, Zhang, Liu, Li, & Tang, 2017). The real power of the smart factory comes from its ability to grow and develop with the changing needs of customer needs and wants; finding new markets; innovation in product and services; more predictive and responsive approaches to operations and maintenance; incorporation of new processes or technologies, or near-real-time changes in production. As a result of having more connected and analytic capabilities, smart factories are able to manage the changing environmental challenges (Burke, Mussomeli, Laape, Hartigan, & Sniderman, 2017).

In the Smart factory system, not only all manufacturing resources such as sensors, machines, robots, conveys are connected and exchange information automatically via internet, but also smart factories will become conscious and intelligent enough to manage and maintain the machines; to control the production processes (Qina & Liua, 2016).

In Industry 4.0, customer demands are collected from the supplier by the help of smart devices with IoT and CPS in the production process. By this way, smart factory can be able to produce the smart product quickly with the support of robot technology. Radio-frequency identification (RFID) tag sensors, automated guided vehicles (AGV) and intelligent robots will be able to recognize the product in the production line and meet the requirements. In this way, different products can be processed without error in the same production line.

Smart factory has some benefits for specific needs of companies such as asset efficiency, quality, costs, safety, and sustainability. By the help of generating data through continuous analysis, companies make required corrections for asset efficiency that decreases downtime, optimized capacity and reduced change over time. The second benefit of smart factory is quality. Self-optimization and maintenance help smart companies to predict and detect quality defects and recall trends in early stages. Furthermore it can help to identify discrete human, machine, or environmental causes of poor quality. Thus, this early detection can decrease scrap rate and lead times. On the other hand self- optimization is also very important in cost-efficiency. It decreases process and operational variability by effective hiring and staffing decisions. A good-quality can also lower after sales service cost like warranty and

Table 10.3 Processes in smart factory (Deloit Annual, 2018)

Process	Sample digitization opportunities
Manufacturing operations	• **Additive manufacturing** to produce rapid prototypes or low-volume spare parts • **Advanced planning and scheduling** using real-time production and inventory data to minimize waste and cycle time • **Cognitive bots and autonomous robots** to effectively execute routine processes at minimal cost with high accuracy • **Digital twin** to digitize an operation and move beyond automation and integration to predictive analyses
Warehouse operations	• **Augmented reality** to assist personnel with pick-and-place tasks • **Autonomous robots** to execute warehouse operations
Inventory tracking	• **Sensors** to track real-time movements and locations of raw materials, work-in-progress and finished goods, and high-value tooling • **Analytics** to optimize inventory on hand and automatically signal for replenishment
Quality	• In-line quality testing using **optical-based analytics** • **Real-time equipment monitoring** to predict potential quality issues
Maintenance	• **Augmented reality** to assist maintenance personnel in maintaining and repairing equipment • **Sensors** on equipment to drive predictive and cognitive maintenance analytics
Environmental, health, and safety	• **Sensors** to geofence dangerous equipment from operating in close proximity to personnel • **Sensors** on personnel to monitor environmental conditions, lack of movement, or other potential threats

maintenance costs. Another benefit of smart factory is labor wellness and environmental sustainability. Smart factories can decrease the environmental footprint more than traditional manufacturing processes and may take on greater levels of judgment and on-the-spot discretion, which can lead to greater job satisfaction and a reduction in turnover (Burke et al., 2017).

Smart factory applications varies for each industry and company. Deloitte has integrated some new technologies, which enable connection and communication between physical and digital assets. Table 10.3 shows samples of digitization opportunities in smart factory process.

10.2.10 Internet of Services

Through web technologies new value added services are made accessible easily (Wahlster, 2014). From a more technological stance service oriented architecture (SOA), Software as a service (SaaS) are strictly related to Internet of Services.

Internet of Services is also defined as an infrastructure using internet to provide consumers with universal services like health, communication and banking. Internet of services provides a business network of research, development, design, marketing, sales, and distribution services to consumer and service providers. Through this network, manufacturers, wholesalers, and suppliers can work together and create superior value (Cardoso, Winkler, & Voigt, 2009).

10.2.11 Blockchain

It is a dispersed digital ledger of transactions, which cannot be debilitated through use of cryptography. This technology has three crucial attributes; decentralization, verification and unchangeability. It is decentralized as the network is conducted by the members instead of a centralized authority like a bank. It is verified as transactions are approved by the public and private key cryptography by the members. As the keys are not related to identities of the members they can keep their anonymity. It is immutable as the transactions in the block can be confirmed by members and if there is no general agreement over the validity of the block, it is rejected. It was invented by Satoshi Nakamoto and firstly known with its cryptocurrency form, Bitcoin (Hackius & Petersen, 2017). Blockchain with its decentralized structure is useful for centralized architectures through supplying unified, verified information for all members of the network. Consequently, it has many other important usage areas other than a form of currency.

10.3 World View of IoT

In 2013, the global IoT market had a size of 485.6 billion U.S. dollars (https://www.statista.com/statistics/485136/global-internet-of-things-market-size/, n.d.). 50 million things are expected to be connected by 2020. 500 billion devices are expected to be connected to the Internet by 2030 (Cisco, Internet of Things at a Glance, 2016).

The US National Intelligence Council added IoT to the list of "Disruptive Civil Technologies" having potential impacts on national power. In 2017, $235 billion was spent on the internet of things market. It is predicted that the combined IoT market will reach $520 billion in 2021, more than double the $235 billion spent in 2017 (Columbus, 2018).

Asia/Pacific (excluding Japan) (APeJ) will be the geographic region spending the highest amount with $312 billion on IoT with/based on 2018 figures. Among these countries, China is the leader with $209 billion. APej is followed by North America (the United States and Canada) with $203 billion and Europe, the Middle East, and Africa (EMEA) at $171 billion (Shirer & Torchia, 2017) (Fig. 10.9).

More customers are considering trying out new usage cases: 60% in 2018 compared with fewer than 40% in 2016.

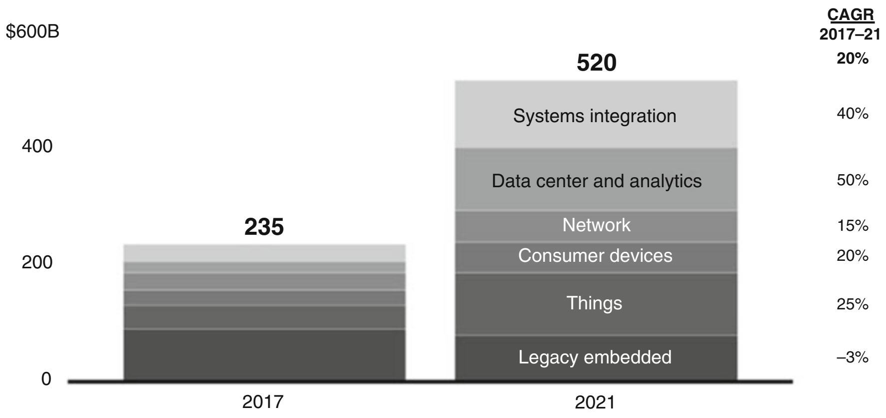


Fig. 10.9 IoT revenue (Columbus, 2018)

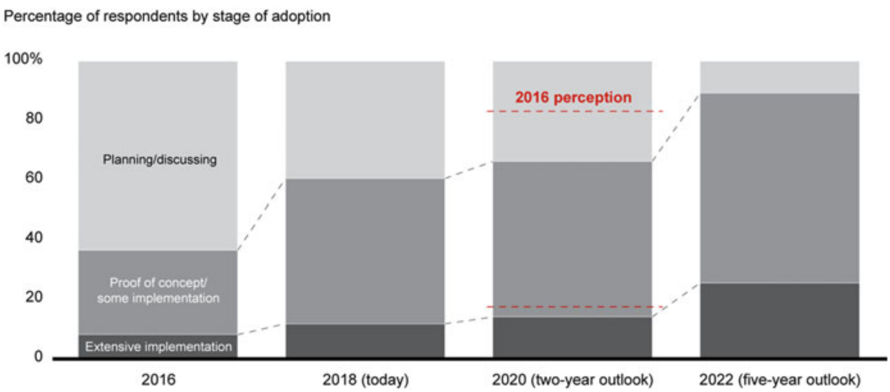


Fig. 10.10 IoT adoption (Bosche et al., 2018)

According to Bain IoT Consumer Survey, firms are investing and are predicted to invest more and more in IoT (Bosche, Crawford, Jackson, Schallehn, & Schorling, 2018) (Fig. 10.10).

10.4 Industry 4.0 in Logistics Sector; Evaluation of Turkey

10.4.1 Digitalization of Logistics Sector

The fundamental aim of industry 4.0 is to use new information technologies for achieving a low cost, high quality, adaptable, potent and sustainable way of production. Digitalization of the industrial sector will lead to a sustainable and robust world

Fig. 10.11 Industries spending according to industries (Nowak, Viereckl, Kauschke, and Starke, 2018)

(Kayikci, 2018). The new trend is supply chain structures with digitalization at the focal point (Özdemir & Özgüner, 2018). Smart factories will not be smart unless they are accompanied by smart logistics processes. Smart logistics will perform the material flow. Autonomous transport equipments like Automated Guided Vehicles (AGVs) will be used for in- and outbound logistics (Stock & Seliger, 2016). Digitalization is a substantial organ for achieving a sustainable supply chain and transportation system. Digitalization in the logistics sector is predicted to create $1.5 trillion value, two million jobs and reduce ten million ton CO_2 emissions (World Economic Forum, 2016b) (Fig. 10.11).

Industry 4.0 endows many opportunities to the logistics sector in terms of innovation, added value and sustainability. According to a model by Kayikci (2018), digital logistics systems lead to sustainability. Through technologies such as robotics, augmented reality, big data, cloud computing, sensors, machine to machine and IoT, and the digitalization characteristics along with the enablers; technology, process, organization and knowledge would/will transform supply chain in such a way that it achieves efficacious results in sustainability dimensions. A case study conducted on six FMCG firms in Turkey reveals that the digitalization of logistics has a significant sustainability effect specifically with respect to the economic dimension of sustainability. More case studies, simulations, experiments are needed to expedite the industry 4.0 adoption in the industries (Kamble, Gunasekaran, & Gawankar, 2018) (Fig. 10.12).

One of the new technologies of the era Industry 4.0 is blockchain technology. Although it initially gained awareness in its cryptocurrency form, it has many other applications some of which have immense importance for the logistics sector. As stated by O'Marah (2017) blockchain presents huge opportunities for the supply chain and logistics (O'Marah, 2017). Nevertheless, there are few logistics firms which have realized these opportunities and started the applications.

Blockchain technology can be used in order to simplify paperwork in ocean freight. In 2015, IBM and Maersk formed a blockchain solution for eliminating inefficiencies in Ocean Freight, preventing fraud in bill of lading and enabling every partner to have information of container status (Allison, 2018). Blockchain also enables origin tracking. To illustrate the giant retailer Walmart partnered with IBM

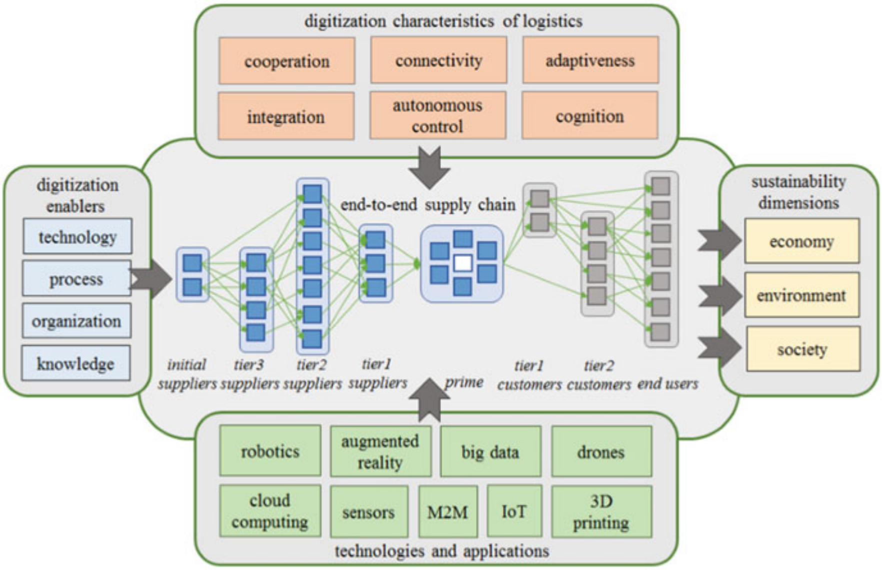


Fig. 10.12 Sustainable digital logistics ecosystem (Kayikci, 2018)

in order to track the movement of food items (Schaffer & Ray, 2018). Apart from providing transparency among all members of the supply chain, blockchain also enables smart tendering through smart contracts. Kouvola and IBM created a partnership for developing a smart tendering system which is sponsored by the European Union (Lee & Pilkington, 2017).

10.4.2 Logistics 4.0 Evolution

Logistics has evolved in the same manner as industry revolutions (Fig. 10.13).

Logistics 1.0

The first change of industry that can be described as a revolution, started with the innovation of the steam machine by James Watt in 1782. After that, a significant increase of the capacity in production was made possible. Along with the steam machine, the innovations in transportation in the nineteenth century lead to the "beginning of the mass transit era" for logistics which was the "mechanization of transport" period (Galindo, 2016). In this era, supply chains were local. For inbound and outbound logistics, push delivery was used. Modes of transportation were only water and rail transport.

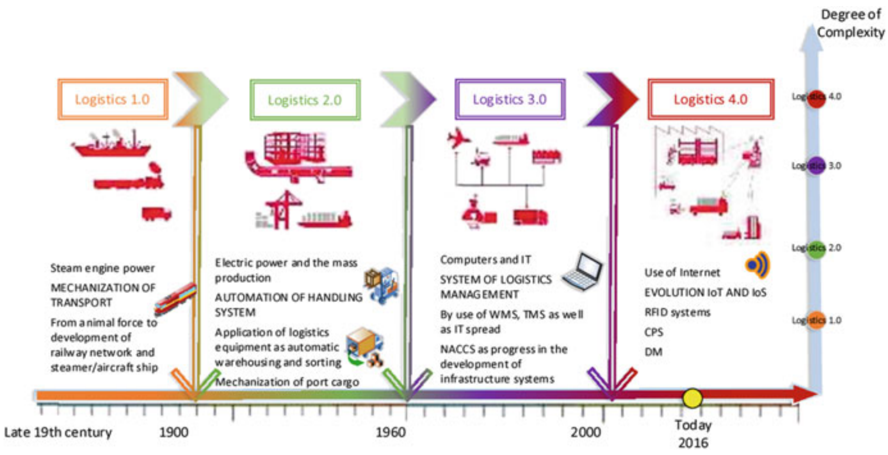


Fig. 10.13 History of logistics (Domingo Galindo, 2016, p. 24)

Logistics 2.0

In this era, cargo handling was automated, automatic sorting equipment and automatic warehouses started to be used. Pull delivery process was used for inbound logistics. Fleet vehicles were utilized for finished goods transportation.

Logistics 3.0

With the intense use of computers in manufacturing, a new era started. Logistics management systems, WMS (Warehouse Management System) and TMS (Transport Management System), and IT systems were used to manage and control the logistics processes.

In this era, supply chain is managed globally. Software is used for planning and controlling the inbound logistics and warehouses. Route optimizations of fleet vehicles are computed by software.

Logistics 4.0

The technologies enable labor saving and standardization of warehouse robots and digitalized vehicles. Hence this reduces the need for human labor (Fig. 10.14).

Through industry 4.0, logistics processes are optimized as all elements, functions are connected and information is shared real time. In this era, logistics infrastructures are standardized.

Industry 4.0 technologies provide improvements in terms of decentralization, self-regulation and effectiveness of the logistics sector. From Kanban point of view, these new technologies provide shorter cycle times. From the JIT perspective, reduced bullwhip effects and integrated supply chains will be the opportunities provided (Hofmann & Rüsch, 2017).

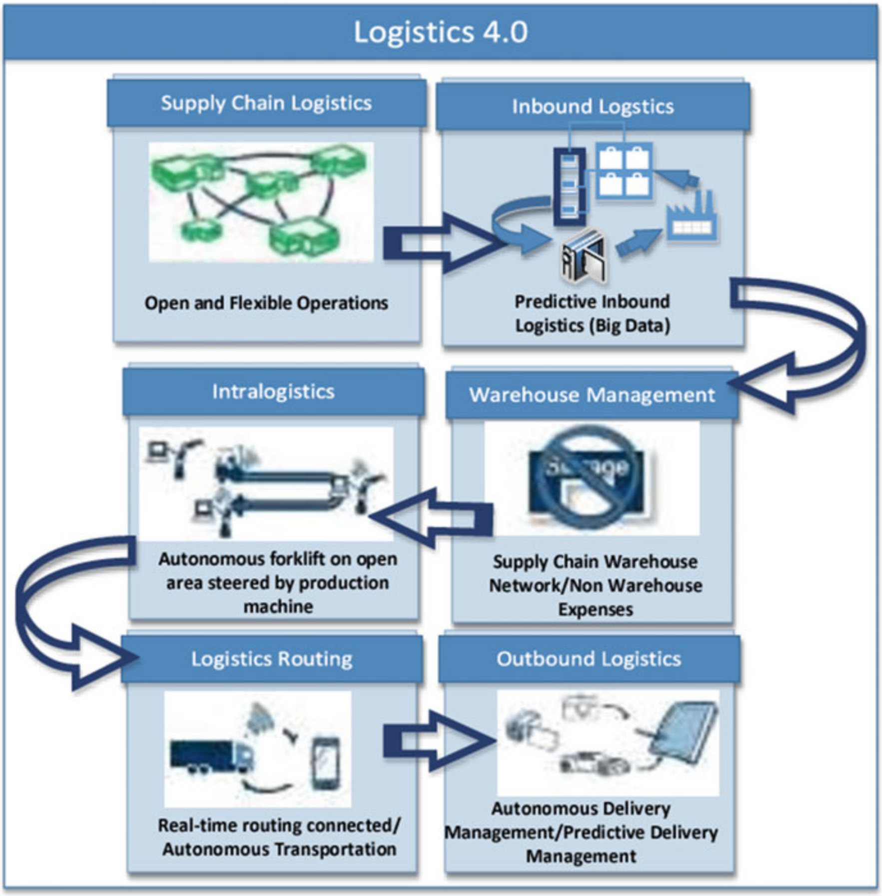


Fig. 10.14 Supply chain management process of Logistics 4.0 (Domingo Galindo, 2016, p. 30)

10.4.3 Logistics 4.0 Applications

Cyber Physical Systems (CPS) used in resource planning increase the flexibility, effectiveness and responsiveness of logistics processes. The integration between the actors of the supply chain increase the visibility and transparency and consequently enable optimized resource planning (Barreto, Amaral, & Pereira, 2017). Warehouses with automated technologies, smart stock systems, and smart shelves increase the productivity and efficiency of storage systems. Robotics is another technology worth mentioning in logistics. Amazon bought a robot manufacturer, named Kiva Systems that has been used for automation of picking.

Transportation Management Systems and GPS technology have already enabled vehicle tracking in the logistics sector. Drone technology is a new mode of transportation of industry 4.0. DHL decided to use drones as an emergency transportation mode. A new version of a drone with flying capacity of 45 min is developed and named as “Parcelopter”. Hitachi Ltd. has developed an automated guided vehicle called “Racrew” and started using it in its logistics center.

10.4.4 Logistics 4.0 in Turkey

According to the Association of International Forwarding and Logistics Service Providers (UTIKAD), industry 4.0 will redefine the throughput process in the logistics sector in Turkey.

The Logistics sector is no exception when it comes to technological advancements in Turkey. The tables (Tables 10.4 and 10.5) below from TUIK data show that the logistics sector is only a little bit below Turkeys average in terms of information technology usage.

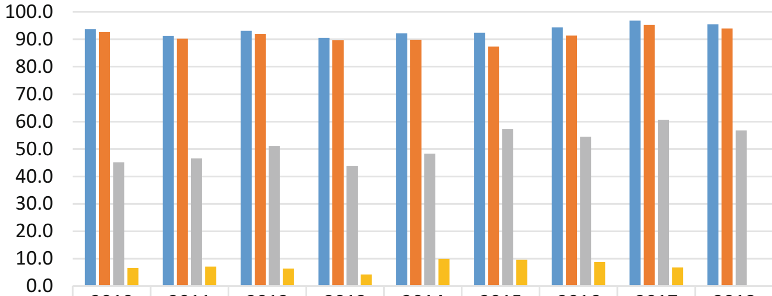
A study analyzing the industry 4.0 perspective of SMEs in Eskisehir, Turkey reveals that firms believe that industry 4.0 could improve the added value of their operations. However it is also perceived as a potential threat for the current state of employment.

Investment cost and know-how inefficacy are perceived as the substantial challenges of industry 4.0 applications (Kagnicioglu & Ozdemir, 2017).

Platform 360 by Koç Sistem offers industry 4.0 applications for the logistics sector (KocSistem, n.d.).

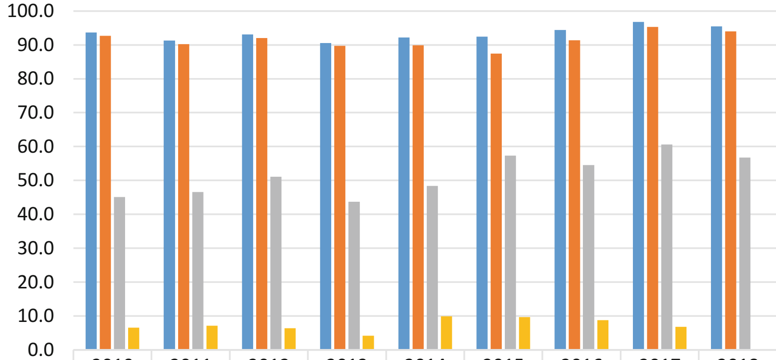
In order to understand the logistics firms’ perspective about industry 4.0 in Turkey, a qualitative study was conducted in Istanbul. The attitudes and beliefs of executives from six logistics firms were analyzed (Doyduk, Karagöz, & Kaya, 2018). According to the study, only large scale companies, as reported by the employee number, have already utilized some scale of digitalization and industry 4.0 applications such as pilot IoT applications, cyber security and tracking systems. The respondents were asked to define the strengths, weaknesses, opportunities and threats of industry 4.0 applications in the logistics sector. The strengths of currently used applications were stated to be increased transparency, real time customer communication, cost reduction, customer satisfaction increase, and inaccuracy minimization. The perceived weaknesses on the other hand were; high initial investment, insufficient financing alternatives and employee technology rejection. Both users and nonusers responded to questions about the perceived opportunities and threats that industry 4.0 has for the logistics sector. The opportunities seen were; advanced control in all processes and increased international market integration. The threats were cyber security problems and higher unemployment rates.

Table 10.4 Total information technologies usage (TUIK, 2018)



	2010	2011	2012	2013	2014	2015	2016	2017	2018
Computer	93.7	91.3	93.1	90.5	92.2	92.4	94.4	96.8	95.5
Internet Access	92.7	90.2	92.0	89.7	89.9	87.4	91.3	95.3	94.0
Own Website	45.1	46.6	51.1	43.7	48.4	57.4	54.5	60.6	56.8
Online Order-EDI	6.6	7.2	6.4	4.2	10.0	9.6	8.8	6.8	

Table 10.5 Logistics sector information technologies usage (TUIK, 2018)



	2010	2011	2012	2013	2014	2015	2016	2017	2018
Computer	93.7	91.3	93.1	90.5	92.2	92.4	94.4	96.8	95.5
Internet Access	92.7	90.2	92.0	89.7	89.9	87.4	91.3	95.3	94.0
Own Website	45.1	46.6	51.1	43.7	48.4	57.4	54.5	60.6	56.8
Online Order-EDI	6.6	7.2	6.4	4.2	10.0	9.6	8.8	6.8	

10.4.5 Internet of Things Use Cases Example from Airport

Another logistics area where Industry 4.0 applications will gain importance is the airports. The fast adaptation of smart products, robotics and other applications provides significant opportunities for internet of things.

Connected Airport concepts integrate passenger facing systems and services and backend operating systems to improve airport operations, increase ancillary revenues, and provide a safe and seamless passenger experience (Fig. 10.15). IoT applications to be used in airports will increase satisfaction, save time, provide greater control, and decrease stress for passengers while reducing costs (energy and labor), improving infrastructure performance, connecting workers and increasing airport safety for management.

New digital airport solutions enhance airport operations and the customer experience from arrival, check-in, baggage drop off, “golden hour”, and finally to boarding. Through IoT technologies, airport and airlines can provide real-time information to decrease passenger stress and travel time, and allow the passenger to better enjoy the concessions and services (Accenture Digital, 2016).

Airports in Turkey began using IoT applications. Datacenters, Passenger Boarding Bridge (PBB) and Queue Management system cases are good examples that will be explained in detail in this section. Internet of things must entail causality. The process requires the detection of the causes that necessitate the use of IoT and its

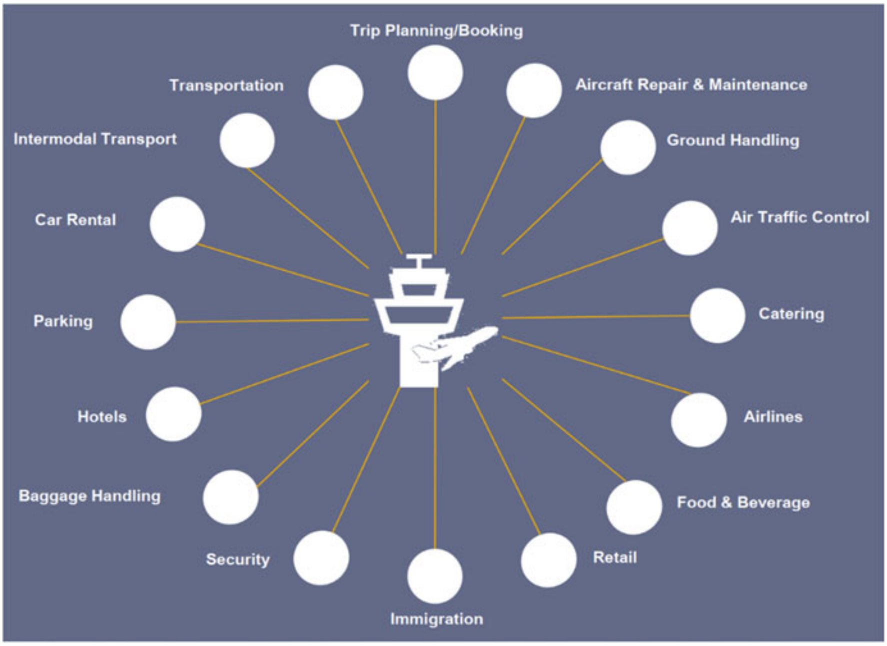


Fig. 10.15 Connected Airport (Accenture Digital, 2016)

components, which generate the data we need in order to deliver the desired outputs. The infrastructure systems that are crucial to modern airport data centers emerge as the examples of such causality. The temperature, humidity, air quality, fluid control and energy metering sensors installed in the data center empower the infrastructure management system to efficiently establish energy, climate and security of the environment. The annual retrospective data from the uninterrupted power supply (ups) and cooling systems records are being used to develop scenarios that facilitate more efficient future use of these two systems. Integrating data-based infrastructure management into the system software provides the means for the artificial intelligence-based machine learning capabilities to automate pre-designed planning. The same data can also be used for planning the predicted maintenance of the data center equipment, enabling the maintenance service to be provided before the equipments break down.

Being an essential airport operational unit, Passenger Boarding Bridge (PBB) stands out as a solution, of which its effectiveness can further be improved by IoT usage. It is possible to analyze the efficacy of 400 Hz ground power unit pre-conditioned air (PCA) services given to the aircrafts boarding by the PBBs. These analyses render the usage rate, staff tracking, BHS (Baggage Handling System) tracking and equipment tracking, thereby allowing efficient management and resource planning of passenger boarding bridges.

Another IoT use case is Queue Management Systems in airports, which use the analytical tools offered by the new generation smart cameras in crowded spaces with human traffic such as airports, train stations, stadiums and malls. As a result, management of passenger movements and passenger comfort solutions are maximized. For instance, the sensors on new generation cameras perform waiting line and crowd analyses, which help designing heat maps. The analyses of the data offered by a heat map yield solutions to reduce passengers' waiting time and accelerate the passenger circulation. In addition, the data are used to implement commercial service planning regarding the passengers, hence presenting income-boosting services.

10.5 Future Expectations from Industry 4.0

The competitive conditions of the twenty-first century have led entrepreneurs to shift their investments to countries with lower production costs. In this process, while developed countries transferred their financial resources and knowledge to the less-developed countries, the latter countries presented their raw materials and labor market to the former entrepreneurs. Thus, countries such as Brazil, Argentina, Turkey, India, Indonesia and especially China had the opportunity to industrialize by using the financial power they obtained from developed countries. As a result of this process, the industrial forces with advanced economies have lost their production competitiveness to the emerging economies led by China, India and Brazil. Developed countries are increasingly in need of a new industrial approach (Industry 4.0) as they lose their competitiveness and face the fact that social spending grows with the aging population. The fourth industrial revolution, pioneered by the US and Germany, appears to be an opportunity for developed countries to regain their lost competitiveness after the establishment of intelligent factories that do not need the labor market to grow, in order to produce more.

In addition to the advantages of Industry 4.0, some concerns about its applicability and consequences have also emerged. The first of these concerns is the contraction of the labor market and the increase in unemployment rates on a global scale. Although there were similar drawbacks at the beginning of previous industrial revolutions, it is a fact that every industrial revolution creates new employment markets based on its production relationship requirements. For Industry 4.0, it is generally accepted that the industrial revolution will reduce the number of blue-collar workers and increase the demand for more skilled labor. The "Future of Jobs Report, 2018" supported by the World Economic Forum (WEF), examined the effects of digitalization on the labor market and made suggestions about jobs for 2022 (WEF, Future of Jobs Report: Employment, 2018b).

According to the report, nearly 50% of the enterprises participating in the research assume that full-time workforce will decrease by 2022 as a result of robots and artificial intelligence in companies. 38% of these companies will improve workforce to new productivity-enhancing roles while 25% of the executives believe that automation will create new roles in jobs. On the other hand, report indicates that 50% of today's main employment jobs will be the same in the following 4 years. The companies involved in the research provide employee 15 million in total and they currently assume that 0.98 million jobs will disappear and 1.74 million jobs will emerge. According to the research, transformation in the workforce will be in two and interconnected ways. Firstly automation and robotics reduce many task related job roles. Secondly an increase in demand in smart products/services produced by these new technologies, which induce the rise of middle classes in emerging countries and demographic shifts, will take place (WEF, Future of Jobs Report: Employment, 2018b).

In the coming period, especially in the fields of data analysis, software, cyber security, robotic applications, e-commerce and social media and digital business processes there will be new positions that need to be equipped with trained personnel. Educational institutions, industry and non-governmental organizations play an important role in the development of this human resource. On the other hand, some jobs and tasks like routine-based, middle-skilled white-collar roles such as data entry clerks in accounting, bookkeeping and payroll clerks, administrative and executive secretaries, assembly and factory workers, accountants and auditors, material-recording and stock-keeping clerks jobs are expected to become increasingly unneeded and be eliminated over the 2018–2022 period (WEF, Future of Jobs Report: Employment, 2018b). According to the World Economic Form 2018 report, stable, new and redundant job roles are given in Table 10.6.

The rise of industry 4.0- automation, robotization, artificial intelligence and machine learning have increased the fear of job losses. Education, training and investment in R&D are the key solutions to overcome this fear. In the new era, employees should have new capabilities in many areas ranging from automation to

Table 10.6 Future expectations of stable, new and redundant roles for different industries (Future of Jobs Survey 2018, World Economic Forum, p. 9)

Stable Roles	New Roles	Redundant Roles
Managing Directors and Chief Executives	Data Analysts and Scientists[a]	Data Entry Clerks
General and Operations Managers[a]	Al and Machine Learning Specialists	Accounting, Bookkeeping and Payroll Clerks
Software and Applications Developers and Analysts[a]	General and Operations Managers[a]	Administrative and Executive Secretaries
Data Analysts and Scientists[a]	Big Data Specialists	Assembly and Factory Workers
Sales and Marketing Professionals[a]	Digital Transformation Specialists	Client Information and Customer Service Workers[a]
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	Sales and Marketing Professionals[a]	Business Services and Administration Managers
Human Resources Specialists	New Technology Specialists	Accountants and Auditors
Financial and Investment Advisers	Organizational Development Specialists[a]	Material-Recording and Stock-Keeping Clerks
Database and Network Professionals	Software and Applications Developers and Analysts[a]	General and Operations Managers[a]
Supply Chain and Logistics Specialists	Information Technology Services	Postal Service Clerks
Risk Management Specialists	Process Automation Specialists	Financial Analysts
Information Security Analysts[a]	Innovation Professionals	Cashiers and Ticket Clerks
Management and Organization Analysts	Information Security Analysts[a]	Mechanics and Machinery Repairers
Electrotechnology Engineers	Ecommerce and Social Media Specialists	Telemarketers
Organizational Development Specialists[a]	User Experience and Human-Machine Interaction Designers	Electronics and Telecommunications Installers and Repairers
Chemical Processing Plant Operators	Training and Development Specialists	Bank Tellers and Related Clerks
University and Higher Education Teachers	Robotics Specialists and Engineers	Car, Van and Motorcycle Drivers
Compliance Officers	People and Culture Specialists	Sales and Purchasing Agents and Brokers
Energy and Petroleum Engineers	Client Information and Customer Service Workers[a]	Door-To-Door Sales Workers, News and Street Vendors, and Related Workers
Robotics Specialists and Engineers	Service and Solutions Designers	Statistical, Finance and Insurance Clerks Lawyers
Petroleum and Natural Gas Refining Plant Operators	Digital Marketing and Strategy Specialists	

[a]Reflects the fact that they might be seeing stable or declining demand across one industry but be in demand in another

sales-marketing. They should be capable of using information technology, controlling and managing intelligent machines and analyzing data from production technologies. Governments, businesses, institutions and other actors have to take actions to prepare and enhance the working environment for this transformation. Training programs should be designed to reskill and upskill three billion people who already are present in the global labor market. They should gain the competencies required by the new era so that the workforce can be articulated to the labor market in this process. Governments have to make basic education reforms starting from early kindergarten through primary to vocational and the university education. This basic education program should include not only the necessary workforce training for individuals, but also the renewed curricula that will teach new skills such as, cooperation, problem solving, creativity, critical thinking, self-recognition and entrepreneurship. In short the competences needed for a future workforce (WEF, Eight Futures of Work, Scenarios and their Implications, 2018a). Training models must provide a prerequisite for being dynamic. New educational policies should not be governed only by educational institutions affiliated to public administration, but also within the framework of the educational strategy of private education institutions that take responsibility in educational life as a result of liberal social relations. Both entities should be supported in order to encourage them to provide training on information technologies, especially research and development (R&D) studies (Yazıcı & Düzkaya, 2016). When the speed of change in technology is considered, the concept of adapting education policies to a certain period in the life of the individuals is replaced with the concept of life-long learning. In order to raise the type of people needed by the fourth industrial revolution, it has become a necessity to update under-graduate and graduate programs of universities. On the other hand, non-profit organizations and institutions can develop agile and portable nets to connect labors to re-training and re-deployment opportunities, minimizing the social cost of labor market disruptions. Another future application to protect the workforce could be "job protection incentives". Governments can bring temporary financial incentives to organizations for reskilling the workforce, such as penalties for automation or robotics production like "robot taxation", to protect and adapt employees to the new period (WEF, Eight Futures of Work, Scenarios and their Implications, 2018a).

With the Industry 4.0 revolution in the next 5–10 years, the design, production, operation and service processes of products and production systems will be completely transformed to new business models. Even though full transition to Industry 4.0 lasts longer, there will be critical developments in the next 5–10 years and winners and losers will be identified. The way to succeed in digital transformation is to make investments in the competence of the systems, the information technologies, the software, the data analytics and the workforce.

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Chapter 11
Digital Transformation of Human Resource Management: Digital Applications and Strategic Tools in HRM

Pelin VARDARLIER

Abstract The introduction of computers in every field of life as the ever-expanding and widespread communication technology, cause significant changes especially in business life. With the internet and technology changing our lives radically, this change has also affected the management forms of enterprises significantly. In today's enterprises, it is seen that the traditional methods used for the management of business processes are no longer sufficient. Business processes that are complicated in enterprises have become manageable only by using technology. Rapid developments in the internet technology have also diversified the understanding and operation of human resources management. Data and resource management of enterprises is more systematic and easily accessible in a digital environment. This situation has enabled most of the work done by the human resources department to be carried out in the digital media. Human Resources Management (HRM) has become Digital Human Resources Management (Digital HRM) due to this transformation. Enterprises now use digital human resources systems while carrying out their human resources functions. In this respect, while enterprises offer many innovations in the digital field to consumers, human resources management also applies similar innovations to employees or candidates. Therefore, digital transformation in human resource processes is more effective when used as part of a broader employment process. In this context, this study focuses on the use of digital applications in human resources management of enterprises. However, the reflections of digitization on human resources processes have also been elaborated.

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11.1 Introduction

One of the trends that shape the business world is the technological transformation, the need to adapt to the digitalized and the changing work environment. Especially, with the increase in the number of employees, enterprise efforts invested in human resources management processes to use human resources technology solutions are increasing day by day. Information technology solutions and digital applications have become the tools that enterprises use to survive beyond making a difference. With the expansion of internet usage, mobile applications and active social media users are increasing, enterprises have begun to work on harmonizing their business processes. In this respect, the differentiation of expectations of employees and employers have resulted different applications in human resources.

Today, internet technology enables all human resource management functions to be carried out faster and easier from the manpower discovery and selection process to training, from the measurement of job evaluation and performance to remuneration, and from rewarding to industrial relations. Today, human resources management is in a rapid change, and it is not just a support function that provides human resource services. It is required from human resources management to be in digital transformation around the world and to lead the changing organizations. This change is especially observed in three areas. These areas are digital labor, digital workplace and digital human resources. With the concept of digital labor, enterprises are working on how they can direct new management practices, innovation and sharing culture, and a range of capabilities applications that facilitate a new network-based organization. When it comes to digital workplace, it is understood that enterprises focus on how to design a working environment that provides productivity. It is aimed to encourage participation by using modern communication tools such as Facebook, LinkedIn, Workplace, Microsoft Teams etc. In the field of digital human resources, enterprises are interested in how they can change their human resources functions by using digital tools and applications (Deloitte, 2017). How digital transformation and automation will have an impact on enterprises and workforce is one of the most important agenda items in the business world lately.

Although digitalization of human resources initially requires a serious resource, reducing time and other costs in the aforementioned issues is only possible by combining technology with resource use. In the new era, enterprises have to create the human resources approach by taking into consideration the innovations introduced by information technologies and social media into our lives. Every employee is an active stakeholder of the enterprise. Enterprises will reevaluate their cooperation with human resources based on knowledge, and will attach importance to the evaluation of newly emerging products and services or the sharing of instant assessments on the operation of the business process. In this context, enterprises should enter into a transparent governance process with all stakeholders as well as with human resources. The change and transformation of information technologies has both increased the effectiveness of human resources and created a new understanding and perception that would require enterprises to reconsider their relationship with human resources. The understanding and functioning of human resources management has also changed with the widespread communication technology (Benligiray, 2006). The widespread use of computers in business life and the rapid developments in internet technology have affected human resources management and the latest point has been digital human resources management. Many businesses now set up digital human resources management systems to provide, process and store information about human resources (Öge, 2004). With the new media understanding, it is seen that enterprises have to use the digitization effectively in all human resources functions; in this way they prefer staff and employee needs by providing speed, cost and quality advantage (Ladkin & Buhalis, 2016). In this context, the concept of digital human resources and the effect of digital transformation on human resources processes are explained in the following sections.

11.2 Digital Human Resources Management Concept

In today's business world of rapid change and intense competition, qualified human resources is one of the strategic resources that provide competitive advantage to enterprises. In order for the enterprise to achieve its objectives, it needs to use the qualified personnel in the right place and at the right time, increase employee motivation and job satisfaction. In addition, all efforts to increase labor productivity and reduce costs and to ensure profitability are called human resources management. The area, which is now called human resources today, used to operate as "Personnel Management" in organizations formerly. The personnel management concept was an area where the operations such as hiring and dismissal in organizations, keeping records etc. and had a business-oriented approach. Human resources management is human-oriented and focuses on issues such as the establishment of enterprise objectives and the determination of strategic decisions. The main objective in human resource management is to ensure that employees serve the success of the enterprise by taking personnel management beyond an administrative function based on norms, rules and bureaucracy and emphasizing their potential and abilities (Vardarlıer, 2015).

The need for information that is related to human resources, including various and different features, the collection, storage and processing of related information can be realized in digital environment thanks to technological advances. In this respect; technology has influenced human resources management on many issues. To meet the applications such as business procedures, job descriptions, organization charts, publication of personnel information, wages, training, career and performance management, employee satisfaction surveys integrally with software, in an integrated manner can be the most suitable solution for the more efficient operation of the enterprise. Digital human resources management is the use of web-based technologies in human resource management practices and policies in organizational life (Ruel, Bondarouk, & Van der Velde, 2007). Lengnick-Hall and Moritz (2003) states that digital human resource management refers to the conduct of business affairs in human resources issues by using the internet. In other words, digital human resource management is defined as "using computer systems, interactive electronic media and telecommunication networks" in order to perform the functions of human resources department (Iraz and Yıldırım 2005). Lengnick-Hall and Moritz (2003) technology trends affecting human resource management are listed as fast and inexpensive access to accurate and real-time human resources, the ability to access information from anywhere, to improve employee productivity, analytical systems, intelligent self-service and personalized content. The access to the information and the ability to effectively analyze, evaluate, interpret, use and share the information are important for enterprises to gain strategic advantage. The ability to access the information means that one can work and manage anywhere at any time. Expert systems, also known as artificial intelligence, will be accompanied by managers at every stage of decision making on human-related issues. The smart self-service event refers to the expansion to include the communication via smart phones and personal data assistants human resource management systems, however, will present filtered information content based on the employee's role within the organization and thus ensure that employees perform optimally (Lengnick-Hall, Lengnick-Hall, & Rigsbee, 2013).

The digital human resources management, which comes up with the increase in the use of communication technologies, brought up the benefits such as increasing productivity with organizational efficiency, decreasing bureaucracy, reducing costs, ending paper usage and creating added value. Digital human resources management accelerates the processes related to many human resources, minimizes the number of administrative processes and perhaps most importantly creates time benefits from job applications without paper, file in brief via internet to e-recruitment, e-training and development, e-performance appraisal, e-remuneration, e-business and talent profiling, e-career management. In addition, it decreases the routine and monotonous business processes of the human resources department and increases its productivity and efficiency, and allows it to move towards strategic areas that are worthy for the organization. The fact that the digital human resources system is fast and easy, which enables employees to improve their skills and increase their performances, makes this system preferred and widely used by organizations and their management (Öge, 2004).

Digital human resources management has three types as operational, relational and transformational human resources management. Operational human resources management provides employees the opportunity of choosing to keep their personal data up to date through the website. Relational human resources management is the part that needs to be selected for the recruitment process to be done through a web-based application or a paper-based method. Transformational human resources management is the development of the workforce in line with the strategic choices of the enterprise and the creation of a ready-to-change workforce (Ma & Ye, 2015). As business with digital human resources becomes more platform-based, strategic business partners are becoming more and more digital. However, the transfer of a large part of the human resources department's work to digital media did not happen in a short time. It is not realistic to expect digital conversion to be easy at a time. This is a great process of cultural change management. Human resources departments are working to create and maintain employee experience by experimenting with digital applications to rewrite rules by redesigning talent applications from recruitment to leadership and performance management. To minimize the problems faced by enterprises in the process of digitization, the features they should have to identify the competencies to adapt the workforce to digitalization develop solutions that will make a difference to the labor force segmentation and start to use the necessary tools in awareness of the risks that this process will bring (Bersin, 2016).

11.3 Digital Transformation of Human Resources Processes

Digital human resources functions are an organizational activity that is undertaken to ensure that the enterprise performs its current and future objectives efficiently, at the right place, at the right time, and at the right number and quality. In this context, it is important to obtain the human resources needed by the organization in terms of quantity and quality, correct and appropriate timing, consistent and economical in terms of tasks, adequate and effective in terms of human resources planning. The presence of qualified and skilled personnel is the key to productivity, efficiency and performance in enterprises. In order for a job to be performed at the desired standards, the personnel who do the job must have some characteristics that are appropriate to the job definition and called job requirements. Therefore, finding and selecting the personnel in sufficient quantity and quality constitutes the primary priority of human resource management in enterprises (Can, Kavuncubaşı, & Yıldırım, 2016). All employee activities starting with planning, job analysis and recruitment process, from the employee to the dismissal process, are functions of human resources. In this context, the digitization process of the basic digital human resource management functions is explained in the following section.

11.3.1 Digitalization of Business Analysis and Business Valuation

The basis of digital human resources practices is business analysis. Today, business analysis is seen as a difficult and cost-effective process for enterprises, now can be done in a digital environment both with observation, interview and survey applications and faster by accessing more realistic information. In addition, the integration of the acquired business information into digital environment and integration into other functions is much easier (Uğur, 2013).

In business analysis, the factors to be used are determined according to the job requirements and qualifications determined by job descriptions. The resulting data are entered into the computers in the work evaluations, made by using the scales extracted from the work analysis. The information transferred to the computers is converted into points for the work that is evaluated through the software and certain points are subtracted for each job. The evaluation of work to be done with the help of computer is developed as a program and used in valuation studies (Vardarlıer, 2016a, 2016b). All from evaluation methods such as sorting, classification score and factor comparison can be applied in digital environment.

11.3.2 Digitalization of Personnel and Payroll Processing

Among the human resources functions, personnel and payroll processes are among the most appropriate departments for digitalization. In this function, digitization refers to the execution of the information and data that will be based on the personnel and payroll processes of the enterprises by recording them on digital media and conducting the work related to payroll and employee personal through this information network. In particular, the staff personal management has become carried out through digital information systems by the widespread use of computers. Computer programs can be used because the law does not specify the way in which files are stored, although there are conflicting opinions in the literature about the fact that the personal files can be kept in a computer environment.

Pricing policies for the employees in enterprises are determined and payroll transactions are made with digital software. These applications can be listed as payroll transactions, debt transactions, registration transactions and side payment transactions. In payroll transactions, the information belonging to all the employees of the enterprise can be tracked from one place; wage calculations can be provided by the establishment of an electronic banking system that gives an automatic payment order to the banks. Furthermore, payables and advances received by the personnel are monitored through this system (Aksel, Arslan, Kizil, Okur, & Seker, 2013).

The digitalization of the personnel and payroll process just started at the recruitment stage. The job application form, transfer or assignment form, proposal form and personal inventory form that have been completed on the system are displayed in the personal section with the registration file that is opened on behalf of the person. The information in these documents is important for profiling and data processing. The form containing the required documents from the start of the recruitment process is sent via e-mail and can be verified by means of barcode or square codes while the prepared form is processed to the system. The appropriate and correct paperwork carries the process to the Social Security Institution which provides and organizes the social security system in Turkey. The Social Security Institution recruitment notice is sent online. After recruitment process, the task definition is made through the system and the candidate is included in the hierarchical scheme. Thus, in trial period or performance evaluations, in cases such as permission and advance approval, etc. where approval is to be received, the manager is defined (Dijital İK, 2016).

One of the first steps of digitalization is the payroll system. At this point, the operations of the payroll calculated in accordance with the legal parameters have been carried out by means of programs without any errors, quickly and with less cost. In other words, digital payroll and remuneration ensures that all payments are made easily, even in companies with thousands of employees. In addition to payroll, advance, execution, side-rights payments and other deduction items can be organized without any problems.

The digitalization of pay-rolling and employee affairs provides a great benefit in terms of collecting, storing and reporting of data, as laws and regulations change rapidly. As a matter of fact, nowadays, it is possible to say that the payroll and personal work cannot be digitized at the desired level as the documents are also to be stored with wet signature.

11.3.3 Digitalization of Training Management

In this age when technology and digitization enter all areas of the enterprise, the scope of information, the way and the speed of access to information are also changing. On the other hand, new channels are emerging in access to information. In the 1990s, the emergence of the World Wide Web and the rapid development of personal training became widespread, and when the 2000's reached, enterprises began to discover the cost and time direction of the digital education that has gained a momentum. The establishment of training environments enriched with digitization is of great importance for the enterprises. One of the most important functions of human resources management is the training of employees. The digitalization of training activities in enterprises is a collection of systems that enable employees to receive training without limitation of time and place by using various communication tools. It has become easier to manage the processes such as determining training needs, planning training, contents of training modules, creating training catalogues, measuring training effectiveness in electronic environment thanks to technological possibilities and facilities (Benligiray, 2006). In other words, through the systems to be established within the enterprise, the training pool in which diversity is at the forefront can be created, the employees can determine their own training, the employees can allocate time to their training at any time, and they can access the training and training material that is defined from their places. However, at the end of the training it will be able to objectively evaluate the effectiveness of the training through the system.

Developments in digital systems also highlight the concept of e-learning in the training. Electronic learning is a remote learning approach and self-learning method. At the same time, electronic learning is mainly learning by using electronic media and especially using computers (Aksel et al., 2013). In fact, it is not possible to digitize some of the mandatory and legal trainings within the enterprise that are defined in the legislation according to the existing legislation. Examples of legal training include training such as high Working at Height, Ergonomics, Fire, Emergency and Occupational Health and Safety. It needs to be defined to persons without a request and included in the "Annual Personal Training Plan" (Dijital İK, 2016). However, there are also training programs that require employees to be trained and development management that are not legally required by the enterprises. Some of these trainings can be given to people via digital methods. Therefore, continuous analysis is required to determine the training needs. It is important to collect data from employees in the analysis of training needs and to draw meaningful conclusions. Employees have the opportunity to enter their training requests on an individual digital platform. By digitizing all these data, analysis of the current situation and reporting of future training planning can be made. The employee can follow the annual personal training plan, requests for training, attendance status, approved and disapproved trainings, training documents, examinations and evaluations, and completed and incomplete trainings on digital training platform.

Human resources managers or training managers can also see the requests for training through the digital training platform, make training announcements, and perform training appointments to employees. At the end of the training, identification of certificates and submission of participation certificates via the system will be made via the system again. It is possible to reach the training participation which is finalized by the digitization of the training management, the status of the planned and realized training and all the training statistics in report format. Although the first installation cost of digital software is considered as a disadvantage, this cost item decreases due to "Open Source" software, a decrease is observed in this cost item (Dijital İK, 2016).

Digital tools that are used in training environments can be classified in various ways. Examples include computer, laptop, projector, smart phone, game consoles, simulator and smart boards as tools used in the digital training process. It is seen that wearable technology is being used more in the field of training with the production and dissemination of electronic tools such as glasses, watches, wireless gloves. It is important to make the necessary efforts to use digital instruments effectively in order to achieve the necessary benefit as training management. Digital training began to live in his golden age with the introduction of social networks in 2010 (Dijital İK, 2016).

Today, many social networking websites have emerged, and they reshape people's communication, interaction, collaboration and even their learning process. Social media tools have many features for the development of training processes. In the research conducted by Toğay, Akdur, Yetişken, and Bilici (2013) to determine the impact of social media on educational processes, it was determined that supporting social media and educational processes were effective in student learning, facilitating learning processes and improving educational processes. Similarly; Gülbahar, Kalelioğlu, and Madran (2010) conducted research on the use of social networks for educational purposes. With this research, the fact that social networks have many features and opportunities, it has concluded that teachers support the teaching and learning processes with active, creative, cooperative learning. In the Capgemini Consulting HR Barometer Survey 2013, the distribution of participants on how to use digital platforms in learning and development differs. In this respect, 18% of the participants stated that they prefer to have face-to-face classroom training in learning and development, again 18% of them use some social learning and development platforms to comply with social media trends, 59% have preferred face-to-face education through e-learning or webinars, the remaining 5% stated that they continued their learning and development processes through the experience and sharing of the other participants with their collaborations in social networks created entirely through digital platforms. Especially due to limited resources such as space and time in learning and development, the trends in the business world are changing very quickly, human resources should have a flexible management ability, which can make quick decisions, in terms of training and development (Dijital İK, 2016).

In terms of training and development, social media, blogs and wikis are the media we frequently use today for both individual and corporate training. Especially Twitter and Facebook continue to be popular with their smart phone applications and ease of access. Thanks to Facebook, a social unifying platform, by creating open or closed training groups by sharing video and training documents; discussion and brainstorming environments can be created. Twitter, the micro-blogging tool, can be used with mobile technologies in online learning processes and in traditional online classroom environments. It is used in the process of training in Twitter to report a change in course content or dates, to share a summary of an article or section, to publish web addresses, to monitor events and to prepare reports by following a specified person (Gülbahar et al., 2010). Wikis, on the other hand, have many connections, the presence of bibliographies are of great importance in training research. It is possible to say that the use of blog in the training is of great importance in terms of its bi-directional contribution and its triggering critical thinking. Thanks to the use of social networks and digital literacy, thoughts and innovations are spreading more quickly than ever before in the world.

In the light of the above explanations, the facts that digital training is open to access from anywhere and anytime save time for people and businesses. It also reduces printed training materials and training travels. Another point is the ability of digital training to appeal to wide masses. Thanks to digital training, employees who are spread across vast geographies can easily receive the training. Finally, studies have shown that digital training increases the persistence in mind when compared to traditional methods.

11.3.4 Digitalization of Internal Communications

The introduction of digitization into our lives and the beginning of digital transformation has brought new applications in internal communication as well as in all areas. When we consider digital internal communication systems, we see e-mail and intranets in almost every company with the most common uses. Although the prevalence of these channels varies from company to company, electronic newsletters, video conferences, digital information screens, webinars, instant messaging tools and corporate social networking and social media channels appear.

Wide networks created through social media provide an excellent information sharing system that can result in referrals and referrals that strengthen voice and communication. However, seeking candidates for employment through social media networks allowed employers and recruiters to contact and connect with the applicants (Grensing-Pophal, 2009). Social networks, beyond finding new connections or maintaining existing connections, the size of established relationships has recently raised concerns that real life will be completely moved to virtual environment. This situation raises the ongoing forms of communication in social networks (Irak & Yazıcıoğlu, 2012). According to the McKinsey Global Institute's 2012 Social Studies: Unlocking Value and Productivity Through Social Technologies survey, estimated productivity increased by 20–25% in companies using social software or socially and digitally connected to employees, and the potential revenue increased by 1.3 trillion dollars a year. The use of social media to develop internal communication strategy provides advantages such as allowing employees to benefit from information and providing instant feedback, and real-time measurement of employee responses and new useful suggestions (Brown and Brown Benefit Advisors, 2012).

According to the "Digital in 2017 Global Overview" report published by We Are Social and Hootsuite, YouTube, the world's second largest search engine, is ranked first when communication and chat applications are examined through the most widely used social media channels in Turkey. YouTube draws the attention of users as a social media tool that allows users to share details about products and services with video content. The second is Facebook, a social networking service where users can create their own personal profiles with a 56% usage rate, add other users as friends, and exchange messages, including automatic notifications when updating their profile. In addition, users can participate in organized and common user groups such as workplace, occupation and industry according to common features in this platform; they can instant message with each other via the website. Instagram with 45% usage rate from other popular social media channels is in the third rank. Instagram that constantly updates itself for enterprises and individual users has a high rate of interaction and a high target audience. The popular micro blogging service Twitter, which allows users to send and read publicly available messages called tweets, with a small margin ranks fourth with a 44% usage rate. These data show the use of active social media tools in Turkey (Kemp, 2017).

When the current situation is examined, it is observed that due to the widespread use of social media, the traditional channels used in internal communication are becoming insufficient. According to Internal Communication and Technology Survey conducted by Melcrum in 2014, 83% stated that they have not yet implemented a technology solution to communicate digitally to implement a technology solution to communicate digitally with off-line employees. It is seen that companies need help in finding solutions that enable them to reach their employees. According to another research by Melcrum, only 11% of companies plan to make mobile applications for internal communications, despite the increase in mobile devices in the workplace. 41% of employees think that the mobile devices they use in the workplace are old and slow (Melcrum, 2014). In this case, employees' increasing digital consumption trends have begun to change the company's perspectives and practices.

In order to achieve this trend, companies should position their own digital internal communication strategies in the internal communication media. Communication channels should be established so that employees can easily access management and social media should be used in communication with employees. Even if the process is accepted at the management level, it must be transferred to every level within the corporate culture. In this respect, the digital conversion in each unit must be managed consciously in the enterprises. As the concept of social workplace and digital workplace becomes more widespread in enterprises, awareness of the importance of internal communication will gradually increase.

11.3.5 Digitalization of Data and Information Management

The only way to be an indispensable element in an organization with human resources department is to play an active role in the strategic decisions of the company by means of information and data analysis. In order to play this role, it is the development of a digital information strategy that coincides with the business strategies set by the company. First of all, the information and data to provide and facilitate decision making by businesses in the planning process and their prediction, can be presented online to managers via computers more accurate, fast and in a variety of formats. If there is an existing database in the enterprise, the data such as the performance levels of the employees, the turnover of the workforce, the rate of absence, the financial opportunities of the organization etc. will be available in this database; it will be very easy and fast to access them. Likewise, the data collected in a fast and more accurate way can be analyzed in different ways with the help of computers and the results can be presented to the managers in different formats (Dogan, 2011). The most difficult step following the human resources digital information strategy, which is determined in line with the business strategy, is the digital integration of data and information management. In this respect, the first key to success in digital integration is that the objective is correctly defined and correctly transferred into the organization.

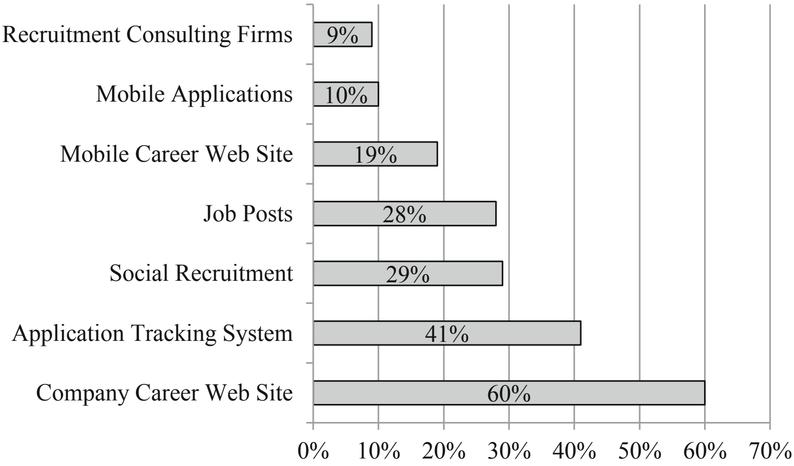
Among the future trends in human resources technologies are the investment in cloud human resources, the data supply of human resources, the realization of human resources software/data on a single platform, and mobile and wearable technologies. Enterprises invest in cloud human resources because of the flexibility they provide to their business processes and the increase in business value. In addition, due to inadequate storage capacity of the devices used by the users to store more and more personal data, the establishment of cloud computing system by enterprises has accelerated. Using cloud computing, personal computer load is reduced and various applications are provided by cloud computing. Thanks to cloud computing, the human resources department and employees can access the data they want at any time. Göktaş and Baysal (2018) talked about the use of cloud computing in digital human resources management in their studies on the digitization of human resources. As a result of the research, it has been observed that the satisfaction of both managers and employees is increased by making things faster and easier in electronic environment with the digitization of human resources. As a matter of fact, since many companies in Turkey do not have the necessary knowledge about cloud computing, they do not have any idea of the benefits this technology will provide to them. Since they could not foresee which of the various services offered by cloud computing would be appropriate, they prefer not to use this technology (Göktaş & Baysal, 2018).

Another point is that human resources need to become data. All transactions must be created and carried out based on the data. To do this, data needs to be kept and secured properly. The "Big Data" concept, which has entered our lives especially after 2011, has a serious opportunity for Human Resources management. Big data is called a transformed form of all the data recovered from various sources, such as social media shares, network logs, blogs, photos, video, log files, into a meaningful and workable format. When the digital integration is carried out, it is necessary to determine clearly which information will be used for the purposes of big data and to decide the information collection and analysis tools accordingly (Dijital İK, 2016). In addition, the data contained in the human resources software must be collected and managed in a single database during the digitalization process. However, it is foreseen that it will contribute greatly to increasing productivity, reducing costs and improving business processes by combining selection and placement of human resources processes, training, occupational safety, internal communication, brand, employee happiness with mobile and disposable technology products. Similarly, according to a survey by PwC's about wearable technology also it is stated that 75 million wearable devices will be used in working environments until 2020 (Ogoo Dijital Blog, 2017). Obtaining and reporting statistical information by comparing the data that continue to increase every day with the information in the past will be especially useful in reaching the outputs that will create value in the decision-making processes of human resources functions. At this point, the information accurately analyzed will be effective in the strategic decisions of the enterprises.

11.3.6 Digitalization of Recruitment

Human resources management recruitment process of enterprises has also changed with the widespread use of the Internet. The process of meeting the human resource needs was carried out by using traditional methods such as announcement of work, newspapers, bulletin boards and career days before the Internet was found. In recent years, recruitment activities such as job placement sites, career networks and consulting have been progressing in online environments. Today, there are important digital tools and social media platforms in order to reach qualified candidates in a short time and at low costs (Williamson & Taylor, 2013). In this respect, social recruitment provides multi-faceted communication opportunities for enterprises as talent is hard to find in employee markets. Recruitment on social media or online can be defined as the "online environment that allows companies and potential job

Table 11.1 Investment priorities in recruitment



applicants to interact with each other" (Maurer & Liu, 2007). Today, Internet and social media have become one of the priority areas of application for job seekers and staffers (Jansen, Jansen, & Spink, 2005).

According to the Jobvite Recruitment Nation 2016 report, the priorities of human resources professionals in investment in recruitment activities are shown in Table 11.1 (Jobvite, 2016).

When we look at the statistical indicators, corporate career websites are seen as the most important element. The application tracking system is another important element in the recruitment process. As a method of recruiting employers, it is observed that they allocate fewer budgets to mobile applications and outsourced consulting firms providing external recruitment support. In this respect, the main objective of recruitment process is to maintain the continuity of the organization through the methods and practices it has to carry out managerial and operational functions, to maintain market share and to have a say in the competition. The first step in selecting and positioning is to identify recruitment strategies. After planning where, how and by which the necessary personnel will be found, the research is carried out (Sabuncuoğlu, 2000).

Many web sites have been launched to bring job seekers and job advertisers together, and Facebook, LinkedIn, Twitter and other social networking sites have been used to search for staff and share jobs (Jacques, 2009). Thus, the use of social media in the process of selection and placement of candidates has become an indispensable situation for enterprises. Human resources recruitment specialists or managers have examined social media accounts of the candidates such as Facebook, Twitter, LinkedIn, and started to establish the first contact with them. It can be said that social media positively affects the future of the recruitment processes, and that it is a pioneer in the diversification of recruitment methods and the discovery of new techniques in terms of human resources management (Vardarlıer, 2016a, 2016b). In Turkey's most widely used social media channels ranking reports, although LinkedIn ranked eighth with 25%, Jobvite ranked first in the recruitment platforms ranking according to the Recruiter Nation (2016) report. The first reason is that LinkedIn is used for professional networks. The second reason is that users keep a list of the contact details of the contacts that they are associated with. Thus, this link list can then be used to create a communication network, track different companies, and assess business opportunities. However, 59% of job-seekers use social media to investigate the company culture of the organizations they are interested in (Kemp, 2017). Similarly, according to the employers, Jobvite Recruiter Nation 2018 report shows that social investments with a rate of 47% and company career website with a rate of 21% and marketing and advertising with a rate of 12% are the largest investments to grow an employer brand. According to the report, LinkedIn ranks first as the most widely used social media channel for recruitment with 77%, and Facebook ranks second with 63%. However, LinkedIn's popularity compared to last year has changed significantly. In 2017, 92% of employers used LinkedIn, this year the rate has decreased (Jobvite, 2018). This may be due to increased interest in Instagram from other social media platforms. The popularity of Instagram among job-seekers has increased compared to other years, and employers invest in recruiting in this medium.

Although it is difficult to find a qualified workforce, it is seen that enterprises are increasingly paying attention to finding qualified candidates when measuring the performance of recruitment processes. According to research conducted on a global scale, companies take into account the quality of the employee in the first place and the time to fill the position in the second place (Headworth, 2015). In this context, cost effectiveness, timing and easy data processing are motivating factors that encourage professionals to choose online methods according to traditional methods. In addition, employers can also obtain information that cannot be included or evaluated through curriculum vitae (CV) or CV with available data on these networks (Sameen & Cornelius, 2015). In another study, Vardarlıer and Özşahin (2017), it has been suggested that LinkedIn from virtual social networks will improve human resource management performance, especially in human resources management and in recruitment process. Facebook is more popular for young people and LinkedIn is more popular for adults than Twitter, according to another survey conducted through social media. In other studies on the use of social media in human resources management, the studies on the use of virtual social networks in the recruitment process of social media tools are noteworthy (Arthur, 2012; Kluemper & Rosen, 2009; Öksüz, 2014; Öz, Keklik, & Kılıç, 2015; Vardarlıer, 2015). As a result of these studies, it has been concluded that social media positively affects the future of recruitment and leads to the diversification of recruitment techniques and the emergence of new techniques. With digital recruitment applications, enterprises can publish their job postings on their own web site and create curriculum vitaes (CVs) of candidates who want to apply for positions via the system. With digital recruitment, it is possible to make quick decisions by reducing the bureaucracy within the enterprise. The recruitment specialist can register his evaluations about the candidate's interviews on the online platform. Digital human resources can filter the CVs on the online platform according to the desired criteria, e.g. education, department, foreign language, location and may find the candidate suitable for business and position without mixing scrambling the paper CVs one by one. The number of interviews conducted during the year, the distribution of the candidates interviewed, the departments where the recruiters graduated, the courses in which they were most successful in their schools, and many of the information already available in big data allow for accurate results through digital analysis programs. Personality inventory, video interview practice, professional analysis test, integration of general skills and foreign language exams into the digital human resources system, the digitization of human resources is advancing not only in multidimensional terms. With recruitment processes ranging from CVs to exams to inventories, digital human resources provide more consistent data for enterprises to explore the appropriate candidate.

11.3.7 Digitalization of Performance Management

Digital performance management is a process that involves the collection, analysis and reporting of data required for the evaluation of employees and organizations. The use of digital technology in performance evaluations is important in terms of both employee career goals and enterprise vision. Transparency, reliability and fairness of the performance evaluation process and all stages of this process can be reached and monitored at any time are indispensable for both work peace and top performance (Aksel et al., 2013).

The performance ensures that the evaluation is carried out online as a whole. Managers and employees can submit performance evaluation data to human resources departments via online forms (Panayotopoulou, Vakola, & Galanaki, 2007). Many enterprises use digital systems that facilitate the performance management process. These systems make it easy for managers to measure performance during the performance management process, write performance assessments, and provide feedback to employees. For example, computerized performance control facilitates performance measurement by keeping variables such as completed jobs, key achievements, time spent on tasks, and error rates (Stone, Stone-Romero, & Lukaszewski, 2006). Especially with 360-degree feedback performance rating, for performance valuation methods such as the Balanced Scorecard method, digital performance appraisal provides an ideal use and increases success (Uğur & Güner, 2017). It is important for enterprises to be able to operate the performance issue correctly and efficiently, especially with 360 degree performance appraisal system and other systems that are developing and becoming increasingly complex. In this context, it has become an area where performance management systems can be measured instantaneously with the digital transformation, the probability of error is minimized, and the comparisons in breakdowns such as periodic or full-time employees, departments can be made easily. Combining the results of processes carried out through web-based or custom software processes with the information obtained from the processes of other functions of human resources and conducting the process from the collection of this information to the analysis on the digital platform will make a significant contribution to the performance management processes of the organizations (Aksel et al., 2013).

11.3.8 Employer Brand and Digitalization

In terms of strategic management, to achieve the strategic objectives of the enterprises and human resources to provide the necessary manpower, they must take place as an employer brand in social media for using social media to attract talented people. By using social media efficiently, the new talented employees to be employed should support in terms of sustaining communication activities that will benefit the enterprises (Vardarlıer & Taşçi, 2017).

In general, using web-based applications and social media to recruit employees is a useful tool in employment. These tools will be used to move the employer brand to digital, as well as the digital communication tools that employees and potential employees use most today for communication. Social media is of great importance for digital human resources as the most important and effective communication channel of digital communication. Social media, which can be used both for internal communication and external communication, is the most important channel where projects considered as the output of the employer's brand are announced. Because the messages published in social media are spread very quickly and viral, the employer can take the brand process to different points. It is especially important to strengthen brand image and reach talented candidates. Many enterprises manage their brands not only on their own corporate websites, but also on social media sites (Öksüz, 2014; Vardarlıer, 2016a, 2016b). The use of social media during employer brand management offers a win-win opportunity for both enterprises and potential candidates. Therefore, the use of social media in employer brand management and human resources processes becomes more effective when used as part of a broader employment process.

11.4 Evaluation of Digital Transformation in Human Resources Management

All the doctrines and studies on the impact of digital transformation on enterprises show that the introduction of digitization into our lives has led to changes in human relations as well as the shape and models of all industrial relations.

Regarding the use of technology in human resources (HR) processes, the results of "Human Resources Technologies Research" carried out by PwC in 2015 with the participation of 650 senior executives in global, 56 from 56 enterprises in Turkey, it reveals what level of enterprises are adapting to digital transformation. Especially, while the use of cloud computing in the world is 68%, this ratio is only 10% in Turkey. In addition, the ratio of enterprises adapting mobile technologies to human resources processes is 70% in the world, while in Turkey this ratio is around 57%. Especially with the increase in the computational power of computers, it has become easier to analyze the accumulated data and make meaningful results (PwC, 2015). Thus, all platforms and social media channels that publish the job advertisement including the business sites of the companies, their job sites and social media channels will be suitable for viewing and application from mobile vehicles. While browsing the internet or on any social media platform, business opportunities that are found to be compatible with the user will appear on the user's screen as a result of digital profile analysis, the digital evaluation centers will gain importance as more advanced version of this.

The digital evaluation center application provides the opportunity to evaluate candidates online for recruitment. As a flexible and cost-oriented evaluation method, the digital evaluation center is a powerful method of predicting a person's future performance. With this assessment tool, many candidates in different locations can be evaluated at the same time. This method is a significant saving for businesses with employees in different locations. The use of social media gamification practices will begin to increase in order to pre-qualify for intensive application areas. In this way, more applications will be received from the target audience and a pre-evaluation will be made simultaneously. Another important advantage is that these technological evaluation methods can be easily integrated into corporate culture in technology-driven companies. In this respect, digitization in human resources enables enterprises to perform video interviews without limitation of time and place in recruitment, to make the examinations online and to reach the results instantly, to make a more consistent and integrative evaluation of the candidate by reporting the results of the personality inventory instantly (Bersin, Pelster, Schwartz, & Vyver, 2017).

The increase of the number of employees in enterprises and the need to make decisions faster have made data analytics important in all processes. In this context, it is seen that the concept called human resource analysis will play a greater role in decision making processes. In human resource processes, the concepts of predictive analytics and people analytics will be used more in the coming years. By means of these methods, the enterprises will analyze the data they have about their employees and will produce more meaningful results, and will make the decision making and planning activities more effective by making inferences about the future through the interpretation of the data (PwC, 2017).

Regarding human resources and learning strategies, Bersin by Deloitte, a worldwide research and consulting firm, published its projections in 2017 in the field of Human Resources. According to the report, the most important point of the changes this year is defined as "digital contact". The popularity of artificial intelligence technologies is one of the major changes observed today. Oxford academics believe that in the next 20 years, 47% of current jobs will need to be redefined. According to the results of the research conducted by Bersin by Deloitte and Massachusetts

Institute of Technology (MIT), covering more than 1000 workplaces at the beginning of 2016, 90% of workplaces think that their work is threatened by their digital rivals. However, 70% of the participants do not think that they have the leadership skills and abilities to adapt to changing conditions (Bersin et al., 2017). Deloitte Human Capital Trends research, which covers 130,000 jobs and 7000 workplaces, demonstrates that 92% of enterprises are not properly organized to succeed, while only 14% of businesses have an idea of how a new organization should be. All of these findings show that technology will force a comprehensive change in corporate structures as well as in our lives. As a matter of fact, the Y generation, which uses technology extensively, also forces enterprises to digitize. With the inclusion of the Y generation into the business world, increasing the commitment of the existing employees to the business has also gained considerable importance. Generation Y employees who are in a hurry and want everything to develop rapidly, expects personalized, fast digital trends from enterprises (Deloitte, 2017).

However, according to the 2017 Global Human Resources Trends Report, which was conducted by Deloitte in 140 countries with the views of over 10,000 human resource and business professionals, the most important priority of the enterprises in the present and future, is to build the organization of the future. Employee experience and performance management constitute the other two items of the agenda. In Turkey especially, the third place in this ranking is the subject of skill acquisition, while career and learning are the fourth place and employee experience is the fifth place. According to the report, the digital human resources issues in Turkey are in third ranks among the priorities for the future with 31% and in global sixth ranks with 25%. Thus, it can be said that digital human resources applications are the most important future priorities of enterprises in Turkey. In the report, leadership is second among the companies' future priorities both in the global and in Turkey. In particular, it is emphasized that leaders equipped with much more agile and digital competencies, with more powerful and diverse features are needed. In this respect, as enterprises attach importance to digitization, managers and leaders will also need to evaluate human resource needs in many different ways in the face of converter technologies. In the report, it is stated that technology and automation and business branches are also redefined, while it is emphasized that values such as empathy, communication and problem solving are becoming much more important. As technology increases its speed and development; in the digitalizing world, our ways of life, work and communication will be restructured. In this context, the enterprises need to change their approach from start to finish in order to attract, retain, motivate and manage the transformed workforce. According to the Deloitte Report, nearly 60% of the companies worldwide and almost 50% of the companies in Turkey are beginning to redesign their HR organization structure in line with the digital and mobile applications. On the other hand, human resources professionals in Turkey think that their functions are weak in the field of cyber security. Those who stated to start using artificial intelligence are 30% in the world; it has been observed that these applications have not yet been used in Turkey (Deloitte, 2017).

Korn Ferry, the global human resources and organizational consulting firm for digital transformation, has conducted extensive research across 5 major sectors in

14 countries to measure digital transformation and guide companies. The "Digital Sustainability Index" created by the research revealed that sustainable digital conversion will not be possible by focusing solely on technology. In this respect, Korn Ferry pointed out that sustainable digital transformation is not only possible with technology, but also with corporate culture, management and employees. In terms of management and organization, a comprehensive survey of five criteria, including agility, connectivity, discipline and focus, empowerment and compliance, openness and transparency, has been conducted in the field of digital sustainability. In the ranking of operations made through five criteria, Austria ranks fourth and Germany, with its strong discourse on digitalization, ranked fifth in the international agenda. In the Korn Ferry Digital Sustainability Index, US companies ranked first in digital sustainability, while the UK ranked second, the Netherlands ranked third and the Turkish companies ranked last. Thus, Digital Sustainability Index according to the results of 2017, Turkish companies, which are the last in the general average among 14 countries, are also listed at the end of the list in terms of connection ability, discipline and focus, authorization and compliance. In the ranking according to the agility criteria of Turkey, which is ranked 11th in the openness and transparency criteria, is ranked eighth. This draws attention to Turkey's potential in terms of adapting to market and environment changes, making decisions and putting them into practice. According to Korn Ferry digital Sustainability Index, financial services ranked first in the sectoral ranking where the top five sectors were taken under consideration. With the exception of agility, financial companies took the lead in the core five sectors with high points in all criteria. In the ranking where the technology sector is second, health sector was third, industry was fourth and retail sector was fifth (Korn Ferry, 2017). Redefining the transformation in the context of ongoing and significant digital change, this research considers digital sustainability as a critical driving force for financial success today and in the future.

Looking at today's data, the 2010 Human Resources Trends report "Rise of Social Enterprise" shows that according to the participants the human resources priorities of enterprises are parallel Turkey and the world. Among the ten most important topics around the globe and in Turkey are inter-functional cooperation among senior managers, data-driven opportunities and risks, twenty-first century career opportunities and employee happiness issues. According to the Human Resources Trends Report for Deloitte 2018 prepared with the views of 11,000 managers from human resources and business world, it is possible to say that it is a difficult process for businesses when concerns about the effects of automation on the business world, needs new competencies, aging workforce and shrinking labor supply are taken into account. The report reveals that, in line with the changing role of the business community in society, the enterprises must ensure that their C-level managers should adopt the problems of society as much as the problems of their own enterprises. The adaptation of artificial intelligence and robotic technologies to the existing workforce, integrated work environment and hybrid labor force management in the focus of new technologies are among the areas where participants in Turkey consider their businesses most unprepared. 28% of participants in Turkey and 49% globally say that they do not have a program that can make their existing employees equipped with the capabilities required by artificial intelligence and robotics technologies, but only 35% say that they plan to train their existing workforce in this direction (Deloitte, 2018).

With the integration of new technologies into business life, senior managers express growing demand for complex problem solving (63% in global, 82% in Turkey), cognitive capabilities (55% in global, 72% in Turkey) and social skills (52% in global, 79% in Turkey). In this context, while 70% of the participants in the global and 73% in Turkey foresee that employees will spend more time on future collaboration platforms, it is predicted to increase both globally (67%) and in Turkey (80%) regarding the use of "work-based social media". In a structure where new communication tools in the workplace allow team-based work, almost half of the enterprises expressed their integrated workforce as a very important issue (Deloitte, 2018).

Another study is carried out with the participation of 674 human resources professionals that 57% of them are working in multinational companies of 13 countries, including Ireland, Austria, Denmark, France, Germany, Greece, Italy, Netherlands, Norway, Switzerland, Sweden, Turkey and the UK in 2018 by the Great Place to Work Institute. Many issues, including human resources strategy, workplace culture, digitization and recruitment, have been evaluated. According to the results of the European Human Resources survey, 55% of participants said that human resources departments do not have sufficient resources and investment in digital conversion. However, the percentage of those who think that human resources departments have insufficient employees is 52% in the report. This ratio also applies to the lack of skilled candidates in the business market. According to 52% of the participants, the talent pool is getting smaller and it is thought that finding a talented employee is difficult. According to the participants, the most important investment that needs to be made in two years is the digitization of human resources processes. According to 41% of human resources professionals, the digital transfer of processes is critical. The ratio of those who think that important processes should be redesigned is 40%. Those who find it important to start innovative management programs are 35%, while those who draw attention to the importance of investing in the employer brand strategy are 31%. 27% of the participants stated that they need to focus on digital education and learning in HR processes (Great Place to Work, 2018). In this context, it can be said that HR departments are on the verge of an important transformation. At the heart of this transformation is digitalization and human-oriented processes. It is an undeniable fact that the contribution of human resources departments to company strategies have increased. In this changing, more competitive world, it is possible to say that the role of human resources departments, as a part of the top management, will increase.

According to the research data; the most complex form of digital HRM involves the transformation of human resources management function in enterprises. From knowledge to automation and transformation, Digital HRM begins to move from more traditional focal points. Therefore, the use of digital HRM has become necessary for all enterprises today and necessitates redefining the rules of human resources. Table 11.2 shows the changing rules of human resources (Deloitte, 2018).

Table 11.2 Changing rules of human resources

Old rules of human resources management	New rules of human resources management
HR departments focus on process design and integration to create standard HR applications.	HR departments focus on optimizing employee productivity and commitment, team work.
HR chooses ready-to-use applications to track the system with the cloud computing system. It uses the cloud management model.	HR creates software programs that follow the learning process from an innovative perspective and develops new applications.
HR technology teams focus on integrating ERP applications.	The HR technology team focuses on developing digital capabilities, competencies and mobile applications aimed at “productivity at work”.
HR excellence centers focus on process design and process excellence. Process management ensures the correct structuring of human resources functions.	HR excellence centers take advantage of chat applications and other advanced technologies to evaluate and strengthen employees. It is expected that the number of messaging applications will increase.
HR programs are designed to meet and maintain scale requirements worldwide.	HR programs create career maps related to careers and career management by targeting employee profiles.
HR focuses on “self-service” as a way to scale services and support.	HR focuses on “activity” to help people do things in more efficient and productive ways.
HR creates a “self-service portal” that runs as a technology platform that makes it easier to find process requirements and schedules.	HR creates an integrated “employee experience platform” using digital applications, case management, AI and bots to support continuous employee needs.

In light of all these considerations, it is possible to say that digital usage in the field of human resources and of mobile usage, proliferation of social media networks, Internet of things, virtual reality and artificial intelligence will develop rapidly and increase competition for talent hunters. Human resources management focuses on process design and implementation to create a standard HR application. If the HR departments want to take advantage of digital technologies, they should prioritize their strategy. Enterprises can become a part of the process by investing in social media, mobile HR Services, cloud HR, integrated HR platforms after identifying their strategies for digitalization. Performance evaluation, recruitment, survey management, recommendation management, training and development management, in-house communication and employee satisfaction activities are managed online and more effectively, thus saving time and cost with the digitalization of processes. With artificial intelligence and robotic technologies taking place more in our lives, recruitment, selection placement, orientation and other human resources routines will be transferred to artificial intelligence supported digital systems. Thus, processes will be managed faster and more efficiently with less labor. For example, it will be possible to perform routine information that human resources should do to the employee during the orientation process, or to answer the questions that employees are interested in, with a chat-bot system instead of a human resources employee. Therefore, companies that add innovative HR technologies to their lives will surely win. While investing in new systems and making the transition seem long and frustrating, there will be many benefits of this change over the long term. Human resources will undoubtedly meet new concepts with digitalization. In the near future, products and tools such as virtual reality glasses, smart headphones and artificial intelligence will also be used in the business world. Companies that are digitizing and investing in new HR technologies will be able to survive in the changing and digitalizing world. Human resources will try to reduce costs through modernization, outsourcing, crowd-sourcing, or mass resource methods, and as companies begin to work in virtual environments the offices will become smaller.

11.5 Conclusion

Human resources management is influenced by many variables, such as globalization, technological advances, and emerging labor markets, as in all areas. Human resources management needs to make these impacts useful in order to keep up with the era and survive. This can be done by doing the activities related to itself in electronic environment and digitizing itself. Digitization provides us with great convenience in terms of time and speed in the whole process from acquiring information to using it. It can be possible that the information obtained from different fields related to different functions can be overlapped by analyzing, and can be converted to benefit only by establishing the correct correlations between the information. However, in terms of human resources, digitization should not turn itself into a goal to show how important they are to employees or to their business top management and to keep up with technology. It is seen as a necessary tool for obtaining, evaluating and using information in the right fields. When the results of human resources processes related to the use of technology are examined, the action plans of the enterprises and the steps to be taken are revealed. Especially in the enterprises that invest in human resources processes, the effort to use human resources technology solutions and spreading it increases day by day. “HR Technologies or Digital HR” units are created in human resources organization structure. In this way, it can be said that with the mechanisms such as easy reporting, analysis and follow-up provided by HR technologies, the time and energy that employees spend on these issues allows them to be spent on becoming a strategic business partner. However, recognizing the digitization of human resources as a point of support to be applied when making strategic decisions rather than merely seeing them as time and energy-saving tools will make business a difference. Examples include harmonizing the skills management processes with the digitization processes in order to attract and retain the skills.

In order to achieve a harmonious coordination within the enterprise, the first issue that HRM should focus first should be to develop strategies and practices that will melt the differences between generations. As the most important goal of HRM has been to establish interconnection with previous generations by developing in-house cultural practices that will ensure the harmony of the new professionals of the Digital Age with others, it is expected that all conventional processes such as traditional recruitment, placement, designation, promotion, performance evaluation are designed to combine these two generations in a single pot. Therefore, the main challenge of HRM work in this period is to manage change without falling into a conflict and contradiction in the level of attitudes, qualities, behaviors and expectations brought by this digitalization.

Another area of digitization in HRM is the digitization of the job itself. With the digital transformation of information, the accessibility and availability of information has opened a new door in the business world. Digital technologies have made it possible to bring the work itself to a whole new level by providing virtual work and virtual environment. Working with virtual teams and working groups, independent of space and time, has liberated both the employees and ensured the flexibility of their time for work. The use of digital applications in all HR processes, from planning to adapt and even developing, is one of today's most important and necessary conditions. All the interaction and support functions of HRM can be managed more effectively with the opportunities provided by digital tools. This ongoing digitalization also brings great opportunities in HRM discipline. First of all, the decline in operational costs is one of the first outputs to be felt. The incredible increase in business speed enables business targets to be achieved in a much shorter time and easily, while the visible and measurable increase in the calibration of HR processes creates significant results. With digitalization, it is observed that there is a significant improvement in the relationship-oriented processes of HRM. For example, digitalization provides more and more effective cooperation and coordination among HRM stakeholders. When you look at change management, the use of digital tools is increasing in all organizational processes starting from orientation. However, the digital practices of HRM in companies have not yet created the desired results. In particular, the limitations created by "user experience", the concerns about sharing information about HRM employees, and the alienation of employees of the way of doing business are the obstacles to this change.

As a result, today's HRM professional's most important goal should be to find the positive aspects of digitization and create the most appropriate way to adapt this process to the company. Nevertheless, HRM discipline has to assess new opportunities with its risks along with the process of digitization. The important thing is to decide what priorities and how to proceed in the adaptation process and to manage this transformation. The purpose of this prepared resource is to serve it. The only way to be an indispensable element in an organization in which human resources are located is to play an active role in the strategic decisions of the company by means of information and data analysis. In order to play this role, it is necessary to develop a digital information strategy that matches the set business strategies.

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Chapter 12
The Transformation of Human Resource Management and Its Impact on Overall Business Performance: Big Data Analytics and AI Technologies in Strategic HRM

Cemal Zehir, Tuğba Karaboğa, and Doğan Başar

Abstract Digitization in the workplace has already affected working methods and the working environment. The digital transformation of Human Resource Management (HRM) is one of the most discussed topics in recent academic studies. In that context, this chapter investigates the transformation of strategic HRM by big data and artificial intelligence (AI) technologies and the impact on business performance. First, we discuss the impact of digital technologies on SHRM and how big data and AI technologies enhance the strategic development of HR. Secondly, the role of technology in HR evolution from 1945 to the present is explored. It can be seen that as technology develops, business also changes the way it manages human resources. Third, the importance of the use of big data and AI technologies in HR functions is discussed. Finally, the ways in which HR contributes to business performance as a result of the digital transformation of HR are discussed. Suggestions and future directions are provided for both HR professionals and researchers to support overall business performance by transforming SHRM into digital SHRM.

12.1 Introduction

Digital technologies have already changed methods of doing business in all sectors. In particular, routine and repetitive tasks are beginning to be conducted by automated systems and machines without human interaction. Strong AI systems are designed with real consciousness and can think and reason like the human brain.

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These systems have cognitive abilities like human beings and have their own consciousness, self-awareness and reasoning ability to solve problems without human intervention. In HR, most administrative, routine and time-consuming tasks are being handled by intelligent systems and machines. The main resources of these intelligent systems come from big data sets, and AI systems create valuable new information by analyzing huge volumes of unstructured and complex data. Big data analytics and AI systems in HR applications enhance the strategic importance of HR. Thanks to digital advances, HR has become more reliable with the reduction in personal judgements and biases in evaluations. Data-driven HR decisions contribute to business performance more than ever before.

In the digital transformation, HR is seen as the major change player. In the past, HR was generally seen as a qualitative function that was far from objective because most HR practices depended on intuition and subjective evaluations. With the help of analytics and AI technologies, the HR department has become more data-oriented and started to take data-driven decisions. As a result, digital technologies have already affected the functioning methodology of all HR practices such as planning and strategy, candidate search, recruitment, turnover prediction, workforce planning, succession planning, engagement and motivation, compensation and payoff, learning and development, talent acquisition and performance evaluation (Falletta, 2013; Kovach & Cathcart Jr, 1999).

Today, HR has huge data sets from within and outside the company. Processing and analyzing big data sets can create great value for both HR departments and overall business operations. For this reason, methods of fulfilling HR functions have already changed, and new HR capabilities and skills are required to cope with digitization in the workplace. Also, HR has started to create and implement digital HR strategies that are aligned with digital business strategies. In today's digital era, the most critical role of HR is successfully managing the digital transformation of the whole organization. In order to do this, HR attempts to change the organizational structure and culture by creating more innovative, creative and technology-oriented workplaces (Daft, 2015; Shamim, Cang, Yu, & Li, 2016). If businesses do not change in accordance with the digital evolution, they will inevitably lose their power and competitiveness and eventually disappear.

The rest of the chapter is organized as follows: First, the change in SHRM with big data and AI technologies is discussed. Second, the effect of technology in the transformation of workplaces and HRM is explored and the evolution of HR with technological developments and the future of workplaces with digital technologies is provided. Third, the utilization of big data and AI technologies in HR functions is discussed. We examine how big data and artificial intelligence technologies develop and transform HR functions and how HR creates value for the company. Fourth, the impact of digital HR transformation on business performance is discussed. We analyze how HR professionals should increase and support organizational performance during digital transformation in the organization with the use of big data and AI technologies. Finally, in the conclusion, future directions of digitization in HR are discussed and some recommendations are provided for researchers and professionals.

12.2 The Effect of Big Data and AI Technologies on SHRM

One of the most important issues in the SHRM field is the effect of strategic HR practices on business performance. Many studies have been conducted to investigate the relationship between SHRM and company performance (Becker & Huselid, 2006; Delaney & Huselid, 1996; Huselid, 1995). There are two important points in these studies: Theoretical background and strategic fit. The theoretical background of the studies that investigate the effect of SHRM on company performance is mostly grounded on the resource-based view of Barney (1991). According to this approach, a company can gain competitive advantage with its resources if they are valuable, rare, imperfectly imitable and not substitutable (Barney, 1991). Human capital is the most important resource in creating value for companies. Human capital is also inimitable and non-substitutable thanks to the special characteristic abilities and capabilities of people (Wright & McMahan, 1992). The other important aspect of SHRM-performance studies is related to the strategic fit. Ericksen and Dyer (2005) defined strategic fit as vertical and horizontal. Vertical fit is related to aligning HR strategies with overall business strategies considering corporate culture, technology, structure and strategy simultaneously. Horizontal fit is related to the consistency and harmony of HR operations and strategies. Strategic HRM focuses on organizational performance rather than individual performance and uses HR resources and systems to increase and support company performance. From this perspective, when HR strategies and applications are aligned with business strategies, significant increases can be observed in overall business performance by decreasing staff turnover and increasing the employee productivity, sales and profits of the company (Becker & Gerhart, 1996; Becker & Huselid, 2006).

In today's digital world, business and HR strategies focus more on digital transformation and the change that is necessary to avoid the disruption of digitization. In this digital transformation, SHRM has gained new advantages to affect organizational outcomes. In the following part of the study, the ways in which SHRM practices change and transform with big data and AI technologies are discussed.

Big data and AI technologies have enhanced the strategic role of HR in many dimensions. One of the biggest impacts of big data and AI technologies on SHRM is closely related to performance management. These technologies have forced HR to think about its value creation abilities for the company. With quantitative and measurable metrics, HR has an opportunity to show its contribution to organizational performance with more concrete data. A data-driven approach to SHRM is important because data eliminates biases and time-consuming steps in performance management. AI-driven performance management systems allow the use of real time performance data and provide more real time feedback to employees and companies. As a result, employees have an opportunity to check and correct themselves to increase their performance and companies can follow real time performance results that provide early signals to improve organizational performance (Buck & Morrow, 2018).

The other important contribution of digital technologies in HR is related to eliminating administrative tasks. With AI and robotic technologies, most routine and standardized jobs, especially low and medium skilled jobs, are at risk of disappearing in the next few years. On the other hand, new technologies such as big data, AI, automation, machine-learning and the Internet of things (IoT) have great potential to create new digital technology jobs, many of which do not exist today (Dehaze, 2016, pp. 36–37). Chatbots and other AI systems can easily perform routine and standardized jobs without error. HR professionals are required to adapt these technologies to use in the organization by guiding managers in handling employees and bots with technology-based management practices (Lengnick-Hall, Neely, & Stone, 2018).

Another impact of digital transformation is that HR is expected to be a major change player in adapting technological developments and reducing the fear of change in an organization. For this change player role, HR needs to overcome two important challenges (Thite, 2019). First, HR should help leaders and employees to create the digital mind-set in their work environment that is required to create digital methods of planning, organizing, leading and controlling the change. Second, HR is expected to transform HR processes and systems with new digital platforms and apps in order to manage the digital transformation of the organization and its employees.

Finally, digital HR increases efficiency and effectiveness in HR functions such as recruitment, selection, performance evaluation, training and development, compensation and benefits. Also, data-driven HR is suitable for the effective use of HR metrics that increase the accuracy and reliability of HR operations by eliminating personal judgements and biases in HR decisions. In addition, as objectivity and measurability in HR decisions increase, the strategic value of HR increases (Burbach, 2019; Parry & Tyson, 2011).

12.3 How Technology Transformed Workplaces and HRM?

Big data is generally defined as "the data that exceeds the processing capacity of conventional database systems" (Dumbill, 2013: p. 1) and is separated from other data sets by its huge volume and high velocity, variety and complexity (Laney, 2001; McAfee, Brynjolfsson, Davenport, Patil, & Barton, 2012; Troester, 2012). The important point of big data for HR departments is the capability of HR people to analyze big data and create value for the business. From this perspective, in order to strengthen the strategic importance of HR, high analytical skills are required in HR people (CIPD, 2013).

Big data analytics and AI technologies are used to extract new information from complex and unstructured big HR data sets. Data-driven decisions and forecasts of the HR department have great impact on business performance with quantitative and reliable HR outcomes. Big data analytics have made HR a better strategic partner by creating value for the whole business strategy (Huselid & Minbaeva, 2018). For example, Falletta (2013) studied 220 high performing businesses and founded that advanced HR analytical practices contributed to the creation of strategic capabilities and competitive advantage.

One step further than data-driven HR is AI-driven HR. AI systems are highly effective in collecting and analyzing complex data sets that require superior computational and analytical capabilities (Jarrahi, 2018). With the opportunities provided by big data and AI technologies, HR's traditional administrative roles have changed, and HR has become more digital, strategic and innovative in realizing organizational goals.

A brief summary of how technology has transformed HR functions from 1945 to the present is given in the table below. This will provide an overview of the role of technology in the HR evolution (adapted from Thite, 2019; Bhuiyan, Chowdhury, & Ferdous, 2014; Rotich, 2015; Johnson, Lukaszewski, & Stone, 2016) (Table 12.1).

As technology changes and develops businesses also change the management of human resources. Also, technological advances have contributed to the strategic value of the HR function in the organization. With the technological advances, dependence on technology in HR functions has increased and HR roles have begun to change. Today's digital technologies such as AI, big data analytics, automation, machine-learning, data-mining and robotics have forced HR to think about its value creation abilities for the company. With digital technologies, the nature of jobs and the ways we organize our work are also changing. Big data and AI technologies will automate administrative, routine and time-consuming tasks and increase automization and the quality of decision-making with data-driven intelligent systems. As a result, both HR managers and leaders from other departments will focus on more strategic, quantitative and measurable tasks.

Today, there are two important roles in the digital transformation of both HR and the whole organization. First, HR should support digital transformation and change in the organization by developing employees with new skills and capabilities. Stephan et al. (2016, p. 97) state that in digital transformation the main role of HR is to "help business leaders and employees shift to a digital mind-set, a digital way of managing, organizing, and leading change". The second important role is related to strategy creation. In a strategic perspective, the main role of the HR department is to support the organization in realizing business strategies and achieving higher organizational performance. In today's businesses, digitization creates higher flexibility, fewer rules, decentralization, team work and collaboration (Daft, 2015; Shamim et al., 2016). Therefore, HR professionals are required to align digital business strategies with digital HR strategies. To achieve this transformation, employees, especially the coming Z generation, will need new skills because of new technology-oriented job opportunities. In the future, most jobs will require human-machine interaction and employees will need higher analytical capabilities, creativity, innovation, imagination, problem solving, empathy and collaboration skills (PwC, 2017).

Table 12.1 The role of technology in HR evolution

Period	HR technology change
Up to the 1940s	*Labor welfare* Primitive technology. Manual, paper-based recording of employee data.
1950s–1960s	*Personnel management* Technology is costly and uncommon. Extensive manual record keeping. Early development of electronic data processing (EDP) to support personnel and payroll
1970s–1980s	*Human resource management* Technology becomes cheaper and more efficient. More diverse legislative base is required to protect extensive employee data. Usage of the first management information systems (MIS) and their adaptation to HRM. New software programs for different HR functions. IBM/360 and other systems to support HR and organization functions. HRIS is generally used to record employee data and to conduct simple analysis of data
1990s–2000s	*Strategic human resource management* Advantages of world wide web software technologies. Extensive demand and use of technology in HR operations. Development of enterprise resource planning (ERP), decision support systems (DSS), IT infrastructure in HRIS. Systems of engagement and integration become important.
2010s–today	*Smart/digital HRM* Cloud-based HR software, active social media and mobile device use in HR functions, metrics and analytics to support HR decisions. Especially in the last 2 years, the advantages of big data, AI and robotics in HR have become evident. Data-driven HR and AI-based HR applications have emerged. HR not only has human resources but also artificially intelligent resources. Use of big data analytics, chatbots, machine-learning, automation, simulation, optimization, intelligent learning platforms and related technologies in HR has increased the efficiency of HR functions. Systems of productivity in network teams and virtual teams.

12.4 Value Creation for HRM from Big Data and AI Technologies

In order to support organizational success, HR needs more quantitative approaches to overcome the complexity of workforce challenges in the business environment. HR analytics are used to create and capture the strategic value from HR data with the purpose of data-driven decision-making and better organizational performance (Angrave, Charlwood, Kirkpatrick, Lawrence, & Stuart, 2016). HR metrics and indicators are key parts of HR analytics and are used to measure HR's effectiveness, to make future predictions about HR tasks and to see to what extent HR outcomes contribute to business objectives. Therefore, the importance of HR metrics increases as HR's big data utilization increases and decisions are based on a quantitative basis. Also, with the help of HR metrics and HR analytics, HR becomes more transparent and reliable because every decision and practice of HR depends on data-based outcomes without the personal judgments and evaluations of HR professionals.

HR Intelligence is “a proactive and systematic process for gathering, analyzing, communicating and using insightful HR research and analytics results to help organizations achieve their strategic objectives” (Falletta, 2008, p. 21). AI systems have higher data processing capacity and they can process huge volumes of big data sets at higher speed than humans. Like humans, these systems can learn by example and recognize objects and their roles in a situation. Also, these systems provide data-driven decisions depending on past, present and future states.

Human-machine interaction is used to emphasize the interaction between HR professionals and intelligent machines or robots. Machines or robots will be the new colleagues of HR professionals in automated HR tasks or they will assist and advise HR people in tasks where human intelligence is not sufficient or rapid enough. Today, especially in high performing organizations, digital HR applications are used in various HR functions from workforce planning to recruiting, compensation, retention, turnover prediction, learning and development, engagement, and performance management (Manuti & de Palma, 2018). In the rest of the paper, we examine how big data and artificial intelligence technologies develop and transform HR functions.

12.4.1 Recruitment and Selection

Hiring the best talent is critical for companies but it is also one of the most time-consuming parts of HR. Today, many high performing organizations use data-driven AI applications for candidate search and recruitment. With the help of AI algorithms, candidate experiences and expectations are measured autonomously and a candidate’s resume and job requirements can be matched automatically according to the candidate’s probability of fulfilling job requirements (Sivathanu & Pillai, 2018). Also, candidates’ engagement levels and potential contributions to the company’s performance can be analyzed with their social media activities and vocabulary used on different platforms. IBM, Capital One, SAS and Oracle are using data-mining effectively to help companies to find and hire the best talent and this kind of recruiting reduces recruitment costs, saves time, increases quality and objectiveness in hiring and provides an opportunity to reach candidates around the globe (Johnson & Gueutal, 2011). IBM’s Watson Recruitment is an AI based application that recommends the best candidates for any job according to the job requirements (Manuti & de Palma, 2018).

12.4.2 Training and Talent Development Programs

Everyone has a different learning style and AI applications can help to individualize corporate training. AI programs respond to individual learning needs, adopt personalized learning styles depending on age, gender, culture, etc. and make them more engaged in training programs. Virtual reality simulations, educational games, chat rooms, asynchronous training and knowledge-management systems are some of the crucial AI-based learning and development tools (Cascio & Montealegre, 2016). Personalized training programs create more effective outcomes for companies and feedback for employees. Also, digital learning and development programs reduce costs, provide flexibility and control and increase the motivation of employees during training (Johnson & Gueutal, 2011). The Watson Talent Development application provides learning documents according to the employee's role, career plans, preferences and personality (Johnson & Gueutal, 2011).

12.4.3 Employee Engagement

Workplaces have no space and time in the digital business environment. Digital technologies have changed employee engagement in two ways: How employees connect and how jobs get done (Jesuthasan, 2017). For example, social media data can provide helpful information about employee engagement and can be analyzed with different methods such as sentiment analyses or text analysis. Facebook, Twitter, email and instant messaging are changing communication and collaboration among employees. Also, digital systems or assistants with AI-based algorithms facilitate an employee's routine tasks and provide extra time for complex and high value activities. Therefore, AI and big data analytical technologies such as social media, communication and collaboration tools and productivity software can be used by HR as enablers of digital engagement in the workplace (Jesuthasan, 2017).

12.4.4 Turnover Prediction

With the help of some machine-learning algorithms, companies can predict the turnover intentions of employees even before recruiting people. Firms define the most important factors that create turnover in a company (such as wages, distance from home, marital status, number of jobs worked before, age, gender, etc.), analyze this personal data with specific algorithms and create a data-driven prediction of the turnover intentions of employees. Thanks to this, HR people can understand the leaving intentions of high performers in the organization and provide a better environment and special opportunities to prevent their departure (Sivathanu & Pillai, 2018).

12.4.5 Compensation and Benefits

Compensation and benefit systems are important for companies to attract, retain and motivate employees and these systems are also valuable when they are fitted with organizational culture, vision and strategy (PwC, 2016). Today, lifestyle incentives that depend on employees' lives and needs, flexible work hours, and team and company performance rather than individual performance are becoming more important (PwC, 2016). Data analytics and intelligent HR systems can create a personalized compensation package according to the personal needs, expectations, performance and contribution of employees. The data processing speed of AI technologies can rapidly scan huge amounts of personal data and help HR to create different offerings for every employee.

12.4.6 Performance Evaluation

Big data and AI applications in HR allow real time continuous performance evaluation of employees and create rapid feedback on what causes a decline in an employee's performance. So, employees can take precautions about low performance indicators without waiting for things to get worse and evaluation results will be free of bias from personal evaluators. Also, data-driven performance outcomes are important for sustainable competitive advantage, transparency and compensation. Digital performance evaluation systems are important for cost effectiveness, time-saving, error reduction and quick decision-making. As a result, they increase company performance by increasing profitability and productivity, sustaining market position and reducing employee turnover (Kar & Srihari, 2018).

12.4.7 Job Design

Job design is important to increase employee performance and to solve problems related to skills, work overload, working environment, engagement, productivity, satisfaction and motivation (Raharjo, Nurjannah, Solimun, & Achmad Rinaldo Fernandes, 2018). Job design is especially important in times of organizational change and transformation. Digital transformation and changes in the work environment require efficient job design. In order to deal with digitization and datafication in the work environment, HR professionals should design jobs considering speed, flexibility and collaboration in the work environment that require job rotation, flexible work assignments, and higher responsibility (Prieto & Pilar Perez-Santana, 2014; Shamim et al., 2016).

12.5 The Effect of the Digital Transformation of HR on Business Performance

The strategic side of HRM requires aligning HR strategies with business strategies that will also increase company competitiveness and performance (Wright & McMahan, 1992). According to the resource-based theory, a firm can gain competitive advantage with its rare, valuable, inimitable, and non-substitutable resources (Barney, 1991). SHRM has its own unique resources to create competitive advantages for a company and to increase overall business performance. That is why many studies have found a positive contribution of SHRM on company performance (Becker & Huselid, 2006; Delaney & Huselid, 1996; Huselid, 1995). In the new business era, data and digitization have changed the way of doing business. From the HR viewpoint, analytical HR has increased the strategic value of HRM with higher organizational performance. Data-driven HR operations have increased the quality and accuracy of HR decisions and provided a better understanding of the strategic importance of HR functions. Also, relying on data reduces judgmental biases and allows HR people to see future trends, make future predictions and take the right steps (Cassar, Tracz-Krupa, Bezzina, & Przytuła, 2018).

A recent survey by PwC of more than 1300 global CEOs emphasizes the importance of digital transformation and change in the workplace. 77% of the CEOs described the introduction of industry 4.0 technologies, AI, robotics and other technological advancements as the biggest trends they are facing (PwC, 2016). So, digital transformation is important in creating business value. That is why HR leaders should use newly developed AI-based analytical systems to support business performance rather than improving individual employee performance scores and engagement levels (Mondore, Douthitt, & Carson, 2011). Also, HR analytical practices need to take an "outside-in" approach and integrate end-to-end business analytics to become successful in supporting organizational performance (Rasmussen & Ulrich, 2015).

Many scholars support the idea that HRM is the most valuable capability to achieve superior organizational performance. On the other hand, some scholars support information technology as the resource for increasing business performance. Turulja and Bajgorić (2016) investigated the relationship between HRM capability, IT capability and company performance. They wanted to distinguish the most important capability for higher business performance, IT capability or HRM capability. The results indicated that HRM capability contributes more than IT capability to business performance. In other words, the direct effect of HRM capability on business performance is more significant than IT capability. This study again confirms that human resources are the most valuable to support organizational performance. On the other hand, IT capability also enhances HRM capability significantly and indirectly supports business performance. So, in today's digital era, HR is expected to utilize the latest technological advances to enhance digital HRM capabilities that will contribute to overall business performance.

Digital HRM is expected to have a measurable impact on company performance. This expectation comes from HR's new ability to transform data into new information and this data-driven information is also critical for business performance. In order to achieve successful digital transformation, HR should transform both itself and the organization simultaneously. Based on previous studies and the reviewed literature from different sources, the following suggestions can be made to HR professionals to increase and support organizational performance during the digital transformation with the use of big data and artificial intelligence technologies (Fairhurst, 2014; Rasmussen & Ulrich, 2015; Schiemann & Ulrich, 2017; Sivathanu & Pillai, 2018)

– Create an analytical mindset for HR professionals. In many businesses, HR professionals do not dominate statistical analytical processes and programs while analytical departments do not dominate HR practices and functioning. Therefore, the necessary solutions to the problems cannot be provided. For this reason, HR professionals should be trained in statistics, science methodology and the interpretation of results.
– Create a technology proponent culture where new trends in big data and AI technologies are welcomed and adapted rapidly to business processes.
– Redesigning organizational structure and HR departments is also important. The speed of developments in AI technologies forces companies to introduce more flexible and flatter organizational structures. Rapid adoption to changing conditions is important for competitive advantage, higher performance and long-term survival.
– Gather, structure, store and manipulate data for necessary analytical processes. There can be huge volumes of data in the HR department. The important thing is the ability to separate the required data for analysis from huge volumes of data.
– Translate a business problem into data analysis questions. From an outside-in perspective, HR should try to support the business to solve stated problems with HR analytical tools.
– HR metrics that are created from an outside-in perspective are now a huge opportunity for a great and sustainable organization.
– Try to transcend solely HR problems by being part of cross-functional business analytics. As HR, generating solutions to what can be done within the scope of HR to the problems that affect the overall performance of the business will also enhance the strategic importance of HR in the organization.
– Follow and select the right technological tools. In order to outperform rivals, businesses should use the latest analytical methods that are not used commonly by rivals. So, to create value for the business, HR needs superior analytical tools and artificial intelligence systems or agents.
– Always remember the "human" side of human resources. HR analytics and intelligent systems can create data-driven decisions for managerial problems but give importance to the experiences and intuition of people when necessary.

– Redesigning jobs is another important subject for HR people. HR should predict what kind of new jobs will emerge in the future with AI technologies and which jobs will disappear.
– When technology continuously develops companies will need people who develop with that technology. Considering the expectations and skills of coming generation in the workplace is also important. HR should try to predict the potential capabilities of new generations and create a balance among multi-generation workforces.
– Transparency and accountability is another concern for HR people. HR should present outcomes to the business clearly. Understanding and interpreting the analysis results correctly and making forward inferences for the business are just as important as analyzing the data accurately.

12.6 Conclusion and Discussions

In this chapter, digital transformation of HRM and its impact on overall business performance is discussed. Digitization in HR is a hot topic and open to new studies from different perspectives. This chapter provides an overview of the impact of technological developments on HR evolution from 1945 to the present and investigates the effects of big data and AI technologies on SHRM practices. HR functions (from recruitment to compensation, training and development, retention, turnover prediction and performance evaluation) are investigated separately in accordance with digital technology adaptation. It is understood that digital technologies in HR have strengthened the strategic role of HRM in the organization. Most of the time-consuming, standardized and routine HR tasks are conducted by intelligent systems and robots. As a result, the administrative burden on HR considerably decreased and HR started to focus on more solution-oriented, strategic, analytical, innovative and creative tasks that are more important to support business success and competitiveness. Therefore, digital HR is now facilitating HR's contribution to the performance of the company. It can be said that digitization in HR is a facilitating mechanism to realize the strategic role of HRM.

The rapidly changing technological environment creates new possibilities in the work environment. In this study, we focused on big data and AI technologies to investigate the digital transformation of HR practices and its impact on business performance. We observed that big data and AI have great potential to revolutionize HR practices but studies in this field are insufficient to create a common understanding. For example, during the study we observed that there is almost no empirical study that investigates the relationship between data-driven HR or AI-based HR operations and company performance. In following studies, researchers can fill this gap by investigating the impact of digital HR practices on company performance. Also, digitization has already changed HR roles and strategies; more creative, innovative and technology-oriented roles have come to the fore. The speed of the HR department and its adaptation to changing technologies and integrated HR platforms have become major trends of today's HR. Therefore, in the future researchers can also investigate new HR roles and strategies in the context of digitization. Also, studies in this field generally ignore the risks of digitization in the workplace and HRM. There are some disadvantages and challenges of digitization and this is a big gap that should be filled in studies to come.

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Part III
Digital Business Strategies and Competencies

Chapter 13
Key Success Factors for Strategic Management in Digital Business

İlker Met, Ertuğrul Umut Uysal, Kadir Serhat Özkaya, and Esra Orç

Abstract Technology improves quickly and every object that comes into direct contact with life is being digitized. The developments in the field of information technologies and the need for digital transformation have led to a rapid change in the traditional ways of doing business. Both the biggest threat and opportunity comes from technology. It can bring on fail for the companies that don't understand the technological developments correctly and adapt to changing environment. It has become an important issue to create a right strategic management model in order to enable firms to evaluate the opportunities and minimise risk during the digital transformation because every enterprise has a different approach to digitalization.

13.1 Introduction

The main factors that must be managed effectively which bring the success during digital transformation are; strategic management, marketing, corporate culture and human resources. The enterprises which consider and try to manage these factors effectively during the transformation period will be successful. Enterprises must confront the ambiguity, manage the digital transformation in a continual cycle and must learn how to harvest in the new era. But, this is a hard job. Many enterprises can't succeed in their digital transformation efforts because they only try to manage the technology. They must also manage strategy, marketing, corporate culture and human resources. In this article, it will be explained how we accepted and managed the digital transformation period in our bank successfully.

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13.2 The Ambiguity in Digital Business

We live in an era full of uncertainty. Game's rule is written all over again. Environment conditions which aren't routine leads the enterprises to an uncertain world. Because the uncertainties could have endless combinations, they are difficult to estimate exactly. These uncertainties could be breakthrough products that are released to market by rivals or it could be a new legal regulation. Firms must be proactive and have a B plan to be ready for all these unpredicted conditions. To manage uncertainty becomes too important than ever before.

It is determined that in a survey conducted by Credit Suisse, in the 1950s, lifetime of S&P 500 list companies was 60 years, while today, this period is stated to fall below 20 years (Sheetz, 2017). Thus, facing with digitalization now requires companies to make more innovative investments and to question the management models and technological capabilities in order to survive in the market.

Within these uncertainties firms spend too much effort for digitalization, but a few fully understand what digitalization really is. For some, digital is a new way of engaging with customers, while for others, it represents an entirely new way of doing business. All definitions can differ depending on the enterprise's perspective. Because enterprises don't know how to start digitalization, it often results in misguided efforts that lead to missed opportunities or false starts (Dörner & Edelman, 2015).

When we look at the digital transformation efforts of the enterprises in industry, we see minority of companies (13%) have been able to refine and reach an advanced level in the process of digitalization. 33% have reached the level of breaking the barrier. 25% of companies are still inactive. The Majority of enterprises (42%) are still in building foundation. As shown in the figure below, companies are aware of digitalization, but they could not have integrated digitization to their business models completely (Lowendahl, Rowsell-Jones, Howard, Nielsen, & Holmes, 2018) (Fig. 13.1).

The other factors that must be considered to decrease ambiguity are the transformation of the *corporate culture, different perspectives in marketing*, *talent shortage, obsolete technology, data security and false news*.

Corporate culture is the biggest obstacle to digitalize processes. Human nature does not tend to go out of the comfort area. When routines change and uncertainty enters their lives, things can easily start to look annoying (Jabil, 2017). A digital transformation can be a symbol of discomfort and can therefore make employees feel threatened. For this reason, a number of factors such as vision, mission, motivation and leadership affecting the corporate culture should be analyzed in detail.

The aging of technologies and infrastructures of enterprises causes the integration of new digital technologies into traditional systems. Because of the negative effects of old applications on business agility, the need for new applications that brings the company high IT budget is one of the biggest problems faced by companies in the digitalization process.

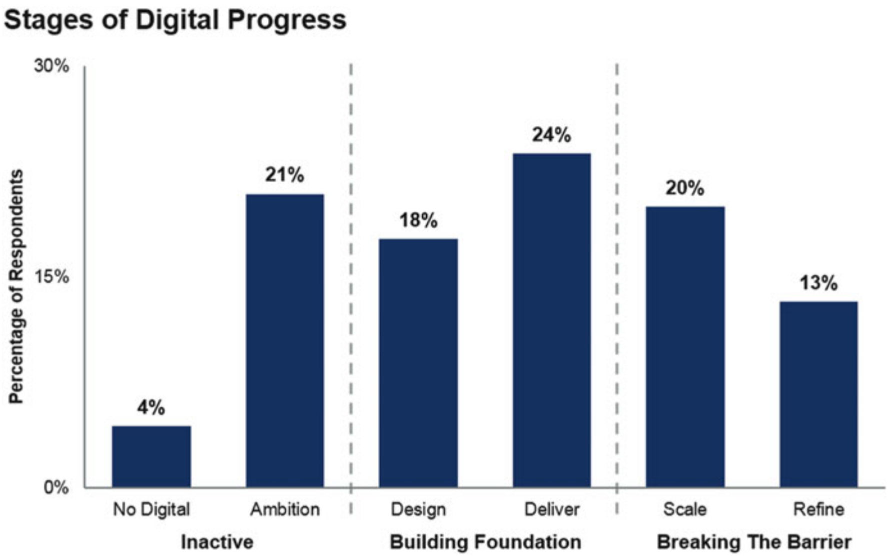

Fig. 13.1 Overall distribution of digital progress (Lowendahl et al., 2018)

Each company aims to provide customer satisfaction by addressing requests and needs of customers. Product-oriented marketing activities have been shifted to customer-oriented marketing. To gain customers loyalty is harder than before, because customer's have high expectations. For instance the fact that information is shared freely and quickly through social media accounts with mobile applications has brought many problems. The sharing of manipulated information by people and information can easily be acknowledged by others, leads to rapid dissemination of false news. In case it happens in an unsatisfied situation about products or services offered by companies, customers can move to another brand easily. Firms need to work more to protect their brand image.

Low supply and high demand for the required talent effect all countries and sectors across the world. Because of this reason, enterprises need to adapt the whole human resources to manage and develop their talents to the requirements of the digitization era. The fact that the labor force changes the job in an easy way is an issue that should be evaluated by the companies (Ünlü, 2017).

The rapid change brings some risks which traditional companies don't have. Security, data privacy, transparency in data usage and ethical issues in the use of new technologies are just a few of these. To respond to these concerns, leaders have to build digital trust and turn this trust into an integral part of products and services (Accenture, 2017).

13.3 The Key Factors for Strategic Management in Digital Business

Steps which are taken to save just the current day won't bring success. It just causes to postpone the problem. To address problems correctly and to estimate opportunities, enterprises need to define and focus on right factors.

It seems impossible to know what will happen in future, but it can be estimated. Therefore, we define five factors that could be important in digital transformation.

13.3.1 Strategy

13.3.1.1 Management of the Digital Transformation

Vision is the starting point for creating the strategies. The enterprise works in a sector and that sector has its own dynamics being affected from the digital developments. These developments may include artificial intelligence, process automation with robotics and internet of things etc. (new technologies).

The new vision of the enterprise at the digitization era has different meanings for the stake holders. Through the new vision new capabilities will be developed. The organizational change will occur. During this transition period the stakeholders receive or provide data from the system in accordance with their own concerns and perspectives. The viewpoint is used to define the position that the stakeholder must look for the elements that are related to his/her responsibility. View is defined as what they see when they look at the point that provides the point of view of the stakeholder. So the leader of the transformation must have the eligibility to direct all the stakeholder's views to work in an harmony because new vision means delivering the value in a new way.

Digitalization is changing the organization, processes, products and earnings of the enterprise. In the digitization era there must be five phases continually going on at the enterprises.

They are ambition, design, deliver, scale and refine which the leaders must take into consideration (Scheibenreif & Geschickter, 2018).

- Ambition is generating interest and excitement around digital business
- Design is creating a minimum viable product (product, service or business unit)
- Deliver is delivering a minimum viable product
- Scale is scaling up the business fully
- Refine is optimizing the digital business and seek new opportunities,

At each phase the leaders of the transformation face some challenges. Every phase can have own difficulties so the transformation teams must take care for every phase. After determining the goals the leader of the transformation must have the qualified personnel for every phase to realize the activities. The transition to the

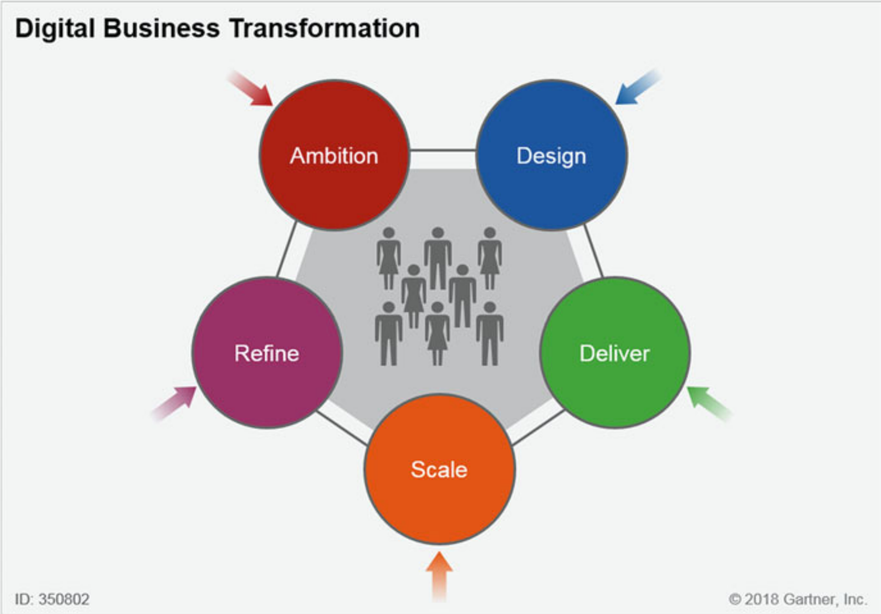

Fig. 13.2 The five phases of the digital business journey (Scheibenreif & Geschickter, 2018)

digitalization is a slow process and the personnel at each phase must execute each phase successfully and transfer the process to the next when the phase is completed in the planned way. It should be remembered that the digital transformation is not a onetime process. Therefore, the IT organization and the enterprise as a whole must develop a permanent capability to execute all five phases of the digital transformation. CIOs should help fellow executives to see what each phase requires and what it will take to repeat the cycle effectively (Fig. 13.2).

Ambition: Phase 1 For creating ambition, excitement through innovation is necessary. Brainstorming of the business units' leaders is important. The CIO must present the outcome from a digital business strategy to the CEO to hold the necessary funds and talented personnel. Funding plan of the projects is important for the continuing cycles in the transition period.

As the figure shown below the Strategic Business Priorities in this phase are listed in a survey conducted (D'Orazio & Redshaw, 2018) (Fig. 13.3).

Design: Phase 2 In the design phase with brainstorming and innovative thinking the business units and the IT units must design a minimum viable product and it must receive attention and excitement. It must also be a minimum loveable product.

Serving from different channels like mobile may be in the scope. The minimum viable product may also have an omni channel vision. The user experience team and process renovation team must work in a harmony.

Top Priorities for 2018 and 2019

Percentage of Respondents

	Financial Services (n = 327)		Top Performers (n = 225)		Typical Performers (n = 2,244)		Trailing Performers (n = 274)	
1	Digital transformation	34%	Digital transformation	31%	Digital transformation	23%	Revenue/business growth	24%
2	Revenue/business growth	18%	Revenue/business growth	20%	Revenue/business growth	21%	Operational excellence	15%
3	Operational excellence	10%	Operational excellence	16%	Operational excellence	13%	Cost optimization/reduction	11%
4	Customer experience	10%	Customer experience	11%	Customer experience	9%	Digital transformation	10%
5	Cost optimization/reduction	9%	Data and analytics	7%	Cost optimization/reduction	8%	Business/financial goals	8%
6	Data and analytics	8%	New products/services	7%	Business/financial goals	7%	Modernization (of legacy systems)	7%
7	Modernization (of legacy systems)	7%	Cost optimization/reduction	7%	Business model change	6%	Data and analytics	7%
8	Business model change	7%	Artificial intelligence/ machine learning	6%	Industry-specific	6%	Industry-specific	7%
9	Security	6%	Business model change	6%	Data and analytics	5%	Enterprise resource planning	6%
10	New products/services	5%	Industry-specific	6%	New products/services	5%	Business model change	5%

Fig. 13.3 Strategic Business Priorities (D'Orazio & Redshaw, 2018)

In the design phase establishing the designed products and services in line with the end user views allows the design to be accepted quickly so user experience testing is important. In this phase, it should not be forgotten that the most important participant of the stakeholders is the end user. The main purpose is to understand or measure people's behavior.

There are many effective examples of user experience processes in the e-commerce, media and IT sectors. Many leading companies such as Microsoft, Amazon, Booking.com, Facebook, and Google are conducting more than ten thousand online controlled experiments annually, with many tests involving millions of users. Startups and non-digital entrepreneurs like Walmart, Hertz, and Singapore Airlines also regularly have conducted these researches. These institutions have realized that the approach of "experimenting with every issue" has surprisingly big gains. Bing, the search engine that incorporates user experiment results into business processes has come to realize that its revenue increased from 10 to 25% each year. In addition to the changes that increase user satisfaction, the main reason why Bing is profitable and the share of calls made from personal computers in the US up to 23% in 2009, when it started to give importance to user experience in 2009 (Met, Erkoç, & Uysal, 2018).

Deliver: Phase 3 After the design phase, the minimum viable product which creates new capabilities is launched in real world. The team must have a target of 3 months to deliver the outputs and there may be a pilot to test the production in real world. Also through 2 weeks or 1 week iteration cycle the progress must be followed. The development of the necessary capability is followed due to the fact that if a requirement can exist and the team must determine if a risk can arise.

Scale: Phase 4 The success of the product or service designed in the design phase must be tracked to figure out the scale. Some metrics can be tracked to understand the success of the design.

An initiative supported by multiple business functions scales up the new digital business on a digital business technology platform, including industrializing operations. Scaling could mean the creation of a new digital unit or the creation of a new marketplace platform.

When it does find one, the enterprise moves from partial deployment to full deployment across the regions where it competes.

Refine: Phase 5 When the service or product is launched the digital transformation begins to occur and the enterprise wins some new digital capabilities. Revenues increase and earnings per share will go up. During the refinement what the competitors are doing must be taken care. Since after refinement ambition phase exists, customer feedback is also very important.

13.3.1.2 Enterprise Architecture Management (EA)

Digital transformation is not a thing that can be integrated into the organization, especially in large enterprises. It should not be forgotten that this is a process that must be internalized and carried out in integrity. In organizations which have more than one business departments, this transformation will not be extended to top-down. The method is to act together by ensuring that all stakeholders have the same perception to serve the same purpose.

As a strategy, it is very important that the digital transformation is adopted by the senior management with full support. Digital conversions made by independent business units must be aligned with the organization's structure, culture and technology.

The detailed plan to guide the implementation of the structure and the system at the component level, which formally identifies the system, is its architecture. By monitoring the interactions between the system architecture and the components that make up it, principles and guidelines are created to manage the design and development over time. In order to disseminate the transformation culture to the organization, its architecture must be well known and analyzed by visualization.

Some methods and tools that should be taken into consideration for the adoption and implementation of strategies will make life easier. Whether it is digital or not, it is necessary to find solutions instead of the difficulties of the destructive effect of strategic changes. Status visualizations that will enable them to take measures against to predict impacts are important outputs in the governance of the organization's architecture.

The need to manage this complexity was felt by the effect of digitalization. The thought structure which started as information system management has gradually turned into whole organization's architectural management perception.

Enterprise Architecture is a comprehensive study that describes the strategies, business processes, data requirements, applications and technology infrastructure of an organization with a certain framework. The basic function of EA is giving information about the objectives, structure, operation, systems used in. EA aims to enable enterprises to achieve their vision and strategic goals and to manage information, process and technology together.

The foundation of EA was laid with John Zachman in the 1980s, and the architectural framework definition studies were initiated as the conceptual structure used for the development, placement and maintenance of architecture.

Afterwards, especially in the military field, the development has gained speed and reached strategic points for corporates with dozens of different frameworks. With the increasing interest of the private sector in this sector, various frameworks have emerged.

Nowadays, we can talk about the Zachman Framework and the Open Group Architecture Framework (TOGAF), which can be adapted to every sector and proved its usability in this sense.

More specifically, the Zachman Framework is ontology—a theory of the existence of a structured set of essential components of an object for which explicit expressions is necessary and perhaps even mandatory for creating, operating, and changing the object (Zachman, 2008).

Although TOGAF does not recognize itself as a framework, TOGAF is actually an Architectural Development Method (ADM). ADM is a prescription of building architecture. Prescriptions can be classified as processes. As an architectural process, Zachman tells you how to classify structures; TOGAF completes Zachman and offers you the process of creating classes.

Within this scope, the interests of EA are;

- Business Architecture, which determines the processes that business units will implement to achieve their goals,
- Application Architecture showing the applications needed in the organization and their relations with each other,
- Data Architecture, which sets out how organizational data resources will be organized and how to access them,
- Technology Infrastructure Architecture that determines the hardware and software infrastructure that will support the applications and their relationships.

Enterprise Architecture drives to guide and assist IT projects, thus ensuring the reliability, interoperability and sustainability of technology, information, infrastructure and business processes. EA not only manages the existing structure, but is also responsible for determining the IT infrastructure and supporting the future plans of the organization within the strategic priorities.

It is possible to define EA as a design between business and IT. It is very important to ensure inter-layer communication. With EA governance new roles are created. These functions have to be distributed in business and IT departments. Form of EA governance is well suited to the nature of enterprises to create organizations that can speak correctly from strategy to infrastructure.

13.3.2 Marketing

Before digitalization in the production period, companies had an approach "*each supply creates its own demand*". Companies that became monopoly in the sector focused on increasing the mass and low-cost production by developing more production techniques rather than customer expectations. One of the best examples was Ford Model T, which was produced in the leadership of Henry Ford and was the first serial production car as a milestone. Between 1908 and 1927, it was produced 15 million. (Ford Motor Company, 2009) Although different colours were used in the production process, Henry Ford chose especially black colour. This is because; black was a colour that dried faster than other colours and fast production possible (Murat, 2016).

At the second phase of marketing, *"I sell what I produce it, as long as I know how to sell"* came to the dominant position. Enterprises that had approach to "each supply creates its own demand" became to change their perspectives. They started to diversify its sales activities in order to ensure that the products they produce are preferred by customers.

In the third phase of marketing, which is known as *modern marketing*, roles have changed completely. In this process, where a customer-oriented approach is dominant, consumers are now more conscious, more organized and have multiple options for product preferences. We can show technology as the main trigger of this change. Technological developments shape the life style and people have considerably become to depend on technology. All transactions ranged from banking to booking can be done via internet technology without depending on location anymore. In an environment where transactions are diverse and customer expectations are constantly changing, how the companies will reach customers and gain them is an important point. Therefore, creating an excellent customer experience has become a strategic issue for companies. Enterprises that offer differentiated products are rewarded with customer loyalty. In this context, it will be an important advantage to analyze big data, develop omni-channel structure, become personalized, be easily and quickly accessible, and focus on using technology with customer perspective as well.

Nowadays there are enormous data coming from the social media and various other channels, especially with the use of internet technology. Due to the fact that this data are not structured, the processing of the data by making meaningful pieces is very crucial. To be able to learn more about the customers and catch sales opportunities for special campaigns has become possible with *big data*. This opens the door to unprecedented opportunities for companies in terms of marketing strategies.

Another way to improve the customer experience is the development of the *omni-channel* structure. The Omni-channel is the process of completing the transactions that consumers have initiated from a channel and then completing it using other channels. Omni channel makes the company's online and offline channels an integral part of its marketing strategy in order to make sure that it is used correctly and in full efficiency. Mobile service to customers in this issue is increasing is importance day by day. Mobile applications and their push notifications are an easy way to reach to customers.

One of the primary expectations of customers is *easy and fast interaction* with companies. Customers don't want to waste time with things that are complex to understand. To wait for a long time to connect call center, try to use applications or websites which is bad usability and not to reach right information in right time are a few examples that bring on customer dissatisfaction. So all processes which are touch points of the customer must be designed as customer oriented end to end. Otherwise, the money spent to gain the missed customers will be very high. Therefore, customization becomes an important factor. *Customization* is defined as satisfying the unique needs of the customers by changing the design of products or services. Some customer information such as age, gender, education, interests and habits of consumers affect purchasing decisions. For this reason, companies that know their customers best and offer them special products starts 1–0 ahead of the competition. For this, it is very important that the behaviors of the customers on the digital platforms are analyzed correctly and present appropriate value suggestions. For example, many online shopping sites offer special product recommendations to customers based on products that are frequently looked for by customers and incline to buy.

Using technology as a customer-oriented approach can be defined as enabling the use of technology to transform products. With the entering of technology in the daily lives, customers' habits have changed. Previously, we needed an mp3 player to listen to music, a camera for taking pictures and a map to find a location. It is now possible to perform all of these activities with a smart phone. In accordance with today's current life conditions, for products it has become an important topic to be gained additional functions and mobility.

13.3.3 Human Resources

Integrating the latest technologies just only into the business processes and using them to ignore human factor don't bring success, because it is human that use technology and add value to them. It will be a wrong policy to see human resources as a cost item and think of filling it with technology instead. The identification and implementation of strategies and leadership are a set of people-specific characteristics that machines don't have. Hence, enterprises need to understand the importance of human resource to keep up with changing conditions. With successful human resources strategy;

- Employee loyalty increases and turnover decreases,
- Employee becomes to be more productive,
- Employee who suits to enterprise's culture and is visional can be hired,
- Employee can adapt to changing easily,

- A more interactive working atmosphere can be created.

In digital era, in order to build a successful human resource policy, it is important to take into consideration to *implement the rotation, automate the routine business and improve the processes, fill talent gap*.

When people do the same work for many years, it can cause operational blindness. As a result of that, people can't open to new ideas and have low motivation. So rotation can make employee more productive. In addition, it will prevent the accumulation of the corporate memory in one person and also provide the backup of the employees.

Determination of routine business processes and moving to automation, definition of failing processes and its improvements are the other key factors that increase employee satisfaction. With the automation of business and process improvements employees spend less time on operational transactions and can do high value-added business.

Nowadays, because of the participation of the generation of Y and Z to the working life, increasing competiveness in labor force market and employee's shifting expectations, enterprises faces serious exams on the management of human resources. According to the Manpower 2018 talent gap report, employers around the world faced the highest talent gap in 2018. 45% of employers say they have difficulty in finding employees with the skills they need (Manpower Group, 2018) (Fig. 13.4).

The reasons why employers can't find the talents they need are;

- Lack of Applicants (*29%*)
- Lack of Experience (*20%*)
- Applicants lack required hard skills (*19%*)
- Applicants expect higher pay than offered (*12%*)
- Applicants lack required human strengths (*8%*)
- An issue specific to my organization (*4%*)
- Applicants expect better benefits than offered (*2%*)
- Other/Don't Know (*6%*)

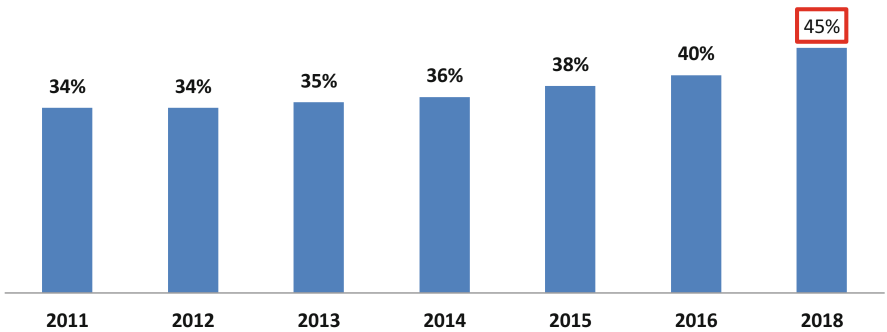

Fig. 13.4 Global talent shortages (Manpower Group, 2018)

A number of strategies can be formed for the recruitment and existing human resource management in order to meet the skilled employee shortage required by enterprises. We can consolidate actions to narrow talent gap in three headlines. These are *"to be attraction center for labor force, to be hired temporary expert employee and continual training"*.

In order to *attract attention of labor force*, it could be better to introduce corporate culture and career opportunities. Otherwise, it will be costly to try to convince the labor force with the salary opportunities. For this reason, department of human resources should act as a marketing guru to attract talented employees. Social media also impress people's mindset in negative way. After reading comments and bad experiences about companies, people can have prejudice and change their opinion. So brand image of company is very important. Enterprises spend extra effort to not give opportunity manipulated information.

Enterprises can't have sufficient human resources and competencies. Organizations can *deal with outside freelance, part time or contracted employees* for short-term projects or work requiring expertise (Manpower Group, 2018). In addition, with the internship opportunities offered by the firms it is possible to determine the employees who are appropriate for the corporate culture and ability that look for. In this way, the time spends on searching for the need employee and enterprises can fill quickly employee's gap they don't have.

Employee is the biggest supporter for reaching enterprises to a higher level and providing a competitive advantage. With well-established *continual training policy*;

- The new recruited employees can get familiar with the company and adapt to the corporate culture and gain the necessary basic knowledge and skills.
- With together self-improvement of employees, they can make more contribution to their companies by ensuring that they have more knowledge about the duties related to their work.
- Keeping close track of innovations in the industry, enabling staff to be more productive and to produce new ideas through know-how they have gained.
- As a result of the importance given to the employees, it makes the employee feel more specific, increases loyalty to the company and decreases turnover.
- Because employees don't have sufficient knowledge and skills, they may be more inclined to make mistakes. These mistakes can have many negative effects, from customer losses to financial losses. Thanks to continual training, operational risks can decrease mistakes which are man-made factors.

13.3.4 Culture

The CIO must establish the suitable climate which forms a culture open for change and helps the digital transformation. The culture must also enforce the enterprise to brain storming and innovation. The enterprises must concentrate on creating value creation with digital developments. The processes of the enterprise will change and people must be willing to participate in the new way of realizing their activities. The transformation process brings with it some risks. Some risks may result with failures. The culture must tolerate these failures. If early failure exists, this helps further success so agile software development can be implemented at the enterprise. Not only agility at software development but also organizational and project management agility to reallocate resources and reorganize is also important. The organization must be fast to react the customer feedback.

Within this framework, firms have to blow away the cobwebs to adapt transformation quickly. Therefore, it is needed to change old habits and management philosophy of the enterprises. Companies are now expected to move into more agile organization rather than traditional models where bureaucracy dominates their organizational structures in the digital era.

Agile organizations viewed as living systems, have evolved to thrive in an unpredictable, rapidly changing environment. They focus on customers, embedding customer-centricity in all they do. They have tried and tested practices that can fluidly adapt and adjust to market changes, innovative technology, customer feedback, and government regulation. They are open, inclusive, and nonhierarchical, evolving continually without the frequent disruptive restructurings required in more mechanistic organizations; and they embrace uncertainty and ambiguity with greater confidence (De Smet, Lurie, & St George, 2018). Embarking on an agile transformation is a major undertaking, but the benefits are great; (Ahlbäck, Fahrbach, Murarka, & Salo, 2017)

- Agile organizations move faster and more adaptable, resulting in greater productivity and reduced cost,
- In agile units, employees are far more likely to provide each other with continuous feedback on both their behavior and their business outcomes. The results show that agile units excel most at creating a shared vision and purpose and alignment on this vision through actionable strategic guidance

To enable agile organization enterprises can follow some steps (Ahlbäck, Fahrbach, Murarka, & Salo, 2017).

First, leaders and people across the organization align on the mind-sets and behaviors they need to move toward. Second, they role-model the new mind-sets and behaviors and hold each other accountable for making these changes. Third, employees are supported in developing the new skills they need to succeed in the future organization.

An important first step in deciding whether to start an agile transformation is clearly articulating what benefits are expected and how to measure the transformation's impact. This vision of the new organization must be collectively held and supported by the top leadership.

Respondents whose organizations have not started agile transformations most often say it's because they lack a clear implementation plan. While the right plan will vary by company, depending on its vision, companies should first identify the part (s) of the organization that they want to transform and how (for example, by prototyping the changes in smaller parts of the performance unit before scaling them up, or by making changes to more foundational elements that go beyond a single unit).

13.3.5 Technology

In 2011, Revolution 4.0, also called Industry 4.0, can be defined as the period in which the most recent transformation wind is felt. This concept is used to describe the fourth stage of the industrial revolution. It has become an area of interest for all the countries that have planned to establish a new industrial system by reaching beyond Germany with the contribution of business and academic circles (İren, 2017). With the support of the necessary legal arrangements, it becomes more widespread and creates more effective opportunities for new products and processes.

It is the basis of a new production philosophy that focuses on "speed, flexibility and efficiency" by using it in conjunction with modern information systems. The focus is on these three topics (Zaman, 2018).

Speed: It focuses on faster time to market.

Efficiency: It is aimed to gain competitive power by using machines instead of people working with muscle power and causing errors in production.

Flexibility: The ability to use the same production line for the production of multiple customized products.

A study conducted by Gartner revealed the most important areas which have priorities in industry. Digital security, Internet of things (IOT) and artificial intelligence (AI) regard as the top priority investments (Rowsell-Jones, Lowendahl, Howard, Nielsen, & Mitchell, 2019).

The introduction of new technologies is experienced in such a short time that it is a skill to perceive and to decide which one to focus on in the organization. It is very important to make strategic decisions about introducing new technologies to the organization.

The use of technology to achieve enterprise's strategic goals is an important factor. This can be an effective tool for new business opportunities or as a supportive topic to fulfill existing business requirements. Even if you are not using technology in the organization today, the future impact and needs analysis will be useful for the organization. The ability to use new technologies for existing or future business objectives will give the organization flexibility.

Firms often fall into two categories: either adopt established and widely used technology solutions and act as market followers, or become market leaders by developing and offering new technology solutions. An organization that is aware of its digital maturity can distinguish in which subjects it is bad or very good. Accordingly, firms can decide whether or not they need to develop their skills by doing benefit analyzes.

At strategic level, decisions should be taken regarding changes in interaction with customers. It is a matter of risk not to be contacted with the customer that the business of the organization is directly in touch. Therefore, the organization should be encouraged to explore the benefits of potential digital changes in its internal and external customer journey. This can be achieved by exploring all customer touch points and by integrating their interactions into various digital or physical platforms. An investment decision should be made for the determination of transformed to-be processes and for claims that are feasible. Investments in research & development will help organizations develop digitized solutions to anticipate customer needs rather than simply responding to existing ones.

13.4 What Have We Done?

We had strengthened the financial structure of our bank and increased the number of customers through the successful transformation projects we have carried out. Our financial statements can be showed as the most concrete example. We focused on customer oriented balance sheet management, sustainable profitability and reducing operational costs.

Within the framework of effective balance sheet management, in order to further finance the real sector it was ensured that the ratio of securities in the asset decreased. We adapted to loan-weighted structure. As a result of that, while in 2011 the share of securities, which had a share of *44% (70.766 mio ₺)* in total assets, decreased by *16% (72.019 mio ₺)* in *2017*, between the same years the share of the loan in total assets increased from *44% (71.430 mio ₺)* to *69% (298.258 mio ₺).*

With a customer-oriented balance sheet structure strategy that is loan-driven growth, Bank assets, which were *160.681 mio ₺* in 2011, increased by *170%* to *434,275 mio ₺*. On the liability side, finding long-term cheap resources and increasing the *non-deposit resource diversification,* both it was used syndication loans and also Bank bill and bonds were issued. The share of non-deposit resources in liabilities, which was *19% (30.253 mio ₺)* in 2011, increased to *24% (98.080 mio ₺)* in 2017.

On the other hand, sustainable profitability and growth is one of the most important targets of our bank. Accordingly, *net profit*, which was *2.101 mio ₺* in 2011, increased by *277%* to *7.940 mio ₺* in 2017. Ensuring successful management of income and expense balance, *the cost income ratio* which was *42.4%* in 2011 decreased to *32.5%* in 2017.

As a result of the efforts to improve the quality of the processes and improve the marketing and sales activities for the customers, the inefficient workload of *4500* person/ year have been eliminated and the employees are directed to high value added jobs.

Behind all the successful transformation projects there is a successful teamwork and management approach. At our transformation project, we have managed effectively the five key factors that are; strategy (ambition, design, deliver, scale, refine and enterprise architecture management), marketing, human resources, culture and technology.

13.4.1 Strategic Approach

The transformation journey was started with the slogan of *"Much Better Altogether"* in order to give the message that the transformation can only be achieved together. This was the way of showing our *ambition* which is the first phase of digitalization. Thus, *"First Step Meetings"* were held which the CEO personally explained to the all employees that transformation was unavoidable, shared possible outcomes and transformation calendar. To inform the employees of the developments in detail and receive feedback from them, *"Sharing Meetings"* were held at quarterly periods, in which the senior management made the presentations.

Within the *design* phase of our strategic plan, transformation program calendar was published through *"Sharing Platform"* where employees were given opportunity to communicate their opinions. *"Transformation Volunteers Team"* was set up which can be a role model for the employees in order to ensure full introduction of new business model and new products in the organization. This team was assigned to adopt the new business model and guided all stakeholders. This has been a path followed in the *delivery* phase in order to obtain the first outputs and the products of the transformation correctly. These were the actions taken in the continuous communication perspective.

Within this framework, *"Strategic Project Plan"* has made a difference with its flexible structure in the transformation program. At the *"Transformation Committee"*, holding weekly meetings with the participation of all the departments, in which results of the projects were followed, problems encountered in the field was discussed and solution proposals were produced.

The decisions taken by the committee were put into action through the systematic established by the *"Enterprise Architecture Team"*. This team would share the action plans with the relevant departments, follow up the progress statuses of the actions, and determine the issues needed to be included in the committee agenda. Strategic project plan was detailed in these meetings, and action plans of maximum 3-months duration were allowed.

This understanding has been carried out by all stakeholders naturally in project and software development processes. Thus, we provided the continuity of the *scale and refine* phases of strategic management by giving an output or product within 3-months duration.

Besides, within the framework of Enterprise Architecture Governance, a meta-model of our organization has been created. With our model that makes the interaction of business and technology visible, shows which capabilities need to be developed. Thus, we can systematize the necessity and prioritization of projects. For this, we have ensured that each project is included in the feasibility process, which yields a huge gain in the decision-making process. By determining scores, it is measurable to determine which project is made in line with which strategic target and which capability is developed. In addition, very large projects are discussed and evaluated by the EA committee and submitted to the senior management.

Even now, this seems to be a very important way of thinking about technology and business to work shoulder to shoulder.

With this vision, our organization provides an end-to-end integrity from strategy to action through enterprise architecture governance. *EA meta-model* of our organization, which is designed in a flexible manner, extends from the vision to the technology infrastructure architecture. This business management model guides us from taking correct investment decisions to process changes, from organizational structuring to human resources management. Thus, interactions on application impact maps can be seen.

Our enterprise architecture meta-model is based on Strategy, Business, Portfolio Alignment, Data Architecture, Application and Technology Architecture.

Strategy Architecture adds architectural events to enable IT project management to be integrated into investment decision processes. Within this framework, it is ensured that the business units can progress by determining the related strategic target, business capability and process. Business Architecture Governance is where all business processes are modeled to ensure the management of current, future and changing activities and competences. Information about the capabilities that the enterprise needs to reach the desired point in the future is provided here. For this purpose, a portfolio alignment is required to decide which capability to invest. The organization of the portfolio is useful when earning a profit in the prioritization of the project.

In order to access information, the data should be managed well and kept up to date. For this reason, data architecture as a component is included in our model. Business and IT architecture relations have been established by revealing the interaction aspects of the applications those work functions. Also, management of the logical technology portfolio for IT support and other applications runs on application and technology architecture. Thus, significant gains are achieved in application development and maintenance costs.

13.4.2 Marketing

In line with our *marketing* strategy "*to be everyone's bank*", in order to ensure that all product management processes are carried out in a special way to the distribution channels, we established a marketing unit as product factory. Thus, both wide range of products, from loan products to foreign trade products are designed and managed by this unit.

We developed different marketing and sales strategies according to the characteristics of our customers who were divided into groups according to their financial needs. With Generation Segmentation, our customers are divided into five main segments (traditionalists, baby boomers, generation x, generation y, generation z) according to their year of birth and the basic marketing / sales strategy for each segment differs. Thus, the development of special products to our customers, marketing and sales activities have been provided.

In order to ensure the continuity of the services we provide to our customers through our digital channels and to determine customer needs proactively within the scope of our multi-channel project, improvements continue to be met before customer demand. In this context, we put into practice digital channel projects.

The User Experience Laboratory and Online Usability Tests (Question-Answer, Click, Navigation, Suggestion, Card Sorting and 5 Second testing) were put in place to take the opinions of the customers on mobile and internet channels. As a result of that, our Internet and Mobil Banking Projects, which include many new functions along with easy, understandable and user-friendly interface have been presented customers.

13.4.3 Human Resources

Various roles for IT and business units have been identified to effectively and rapidly manage project management processes. Together with our changing business processes ten important concepts have entered our lives. These roles are Product Owner, Business Architect, Technical Product Owner, Devops, Technic Leader, Quality Assurance, Project Manager, Business Analyst, Developer and UX Designer. Thus, rather than working in silos, *the agile approach* has been implemented within the organization entirely. The most critical role in the project team belongs to the *product owner* representing the business units both project stage and after project is completed. Product owner's duties are; identifying business strategy, objectives, capabilities and rules ensures the creation of standards for products under the responsibility, determining the processes and control points related to the products under its responsibility, giving user acceptance approval for products which are deployed.

Business architect is responsible for modeling the effects of the project on the business architecture throughout the project. They act as a bridge between the Information Technology units and the Business Units at the bank. Business Architect determines the impact of the project on the strategic targets the business capabilities/functions and processes that it has changed and developed. He is also responsible for designing "TO BE" processes. He plays an active role in resolving problems between business units and information technology departments.

In line with our new core banking software project, it is aimed to position the product owner's role in all units within the scope of the products/capabilities they are responsible for. Within this scope, agile project management trainings are organized to share information about "how to run new project methodology, the concepts used in agile management, benefits of agile project management, why it is necessary for our organization and expectations from the project stakeholders and product owner". Thus, it is ensured that the users are informed about the implementation of the new methodology and the projects processes are managed in a more professional manner.

13.4.4 Culture

Companies should be aware that the transformation cannot be successful unless the employees believe it. It should be ensured that the employees adapt to the digitalized business world and the awareness that this process will be experienced continuously. This should be felt as a culture. All stakeholders should take the same steps in a harmony with the full support of senior management.

We are trying to adopt certain methods to involve our employees in this process, where the transformation is continuous. Periodically, our *"Innovation Bulletins"* are published, which include technological research and sectoral innovations. *The Suggestion System*, which allows employees to convey their ideas and suggestions by benefiting from their knowledge and experience, has been implemented.

A unique project management model was formed to ensure synchronization among projects and to integrate transformation into corporate culture. Each project was shaped in line with the basic principle of sustainable profitability and productivity and the milestones of the transformation program were prepared. The approach of participatory and agile project management played a significant role in the internalization of the transformation by the corporate culture.

We adopt the MVP approach in line with the leanest and usable products principle that provides the minimum functions that the customer/user needs. Products coming to MVP stage are offered to users without waiting for the entire project to finish. If the output is not produced for a long time, the motivation of the teams decreases. So avoiding this problem we encourage the project teams to produce output in certain periods. In this way, improvements are made in the projects according to the opinions of the users and solutions can be produced early solutions for the problems encountered.

13.4.5 Technology

As Wood (2009) says, "change has never happened this fast before, and it will never be this slow again."

As technology evolves, we need to continue to transform as customers' needs change. In this sense, our core banking system to support new business model is also updated. In our user-friendly application with new infrastructure and frontend, we are working to achieve a flexible structure that can be developed fast and at a low cost. Besides on screen prototypes developed within the scope of new core banking software *The User Experience Laboratory* and *Online Usability Tests* (Question-Answer, Click, Navigation, Suggestion, Card Sorting and 5 Second testing) were put in place to take the opinions of the employees.

Also within the scope of the transformation plan, our business model and organization structure is restructured with the principles of customer focus. To achieve this important development and rapid gains our core banking system to support new business model is also updated. In our user-friendly application with new infrastructure and frontend, we are working to achieve a flexible structure that can be developed fast and at a low cost.

We have implemented Robotic Process Automation (RPA) within the scope of simplification and centralization of business processes. We are creating the areas where we can use the software that performs routine work processes and makes simple decisions by imitating human. In our organization, RPA technology is used in our processes such as tax-insurance collections, sending e-notification documents to the concerned parties and creating insurance policies. Thus, our employees are directed to more productive jobs.

For the software/hardware problems encountered by the employees during the day, the service desk application is expected to be solved. Virtual assistants have been created with the help of artificial intelligence that supported chatbot application. Chatbot learns by analyzing the questions asked in the previously opened call records and the answers given.

To provide competitive advantage, Application Programming Interface (API) is defined as an open source for the functions of our service application to be used in other applications. An API pool is created to provide benefit and profit that is expected to create sector advantage.

In order to clearly understand the capabilities and limits of Blockchain technology, to identify business opportunities and potential impacts, research and development activities are continuing by our organization.

13.5 Conclusion

Digital transformation is a never ending journey. As stated in the article it has a cycle beginning with ambition. But not so many firms have been able to complete the cycle and begin to harvest. Enterprises have been struggling with many factors. Since people will succeed digital transformation, at first corporate culture must be renewed with full support of the transformation leaders. As we are in 2019, the time to harvest is closing. So, the enterprises must be insistent to realize their technological investments whatever it is robotics, artificial intelligence, machine learning etc. The leaders with minimizing all the change risks must have a strategy and a transformation road map, not just saving the current day.

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Chapter 14
Platform Strategy for Business Transformation in a Blockchain Ecosystem

Sang-Wuk Ku

Abstract This chapter explains blockchain platform strategies for business transformation in a blockchain ecosystem. The blockchain platform, which includes specific transaction records and distributed ledgers for certain time periods, can be defined as (1) a core asset in a blockchain ecosystem, (2) a common basic asset, (3) an asset possibly generating derivative content and services, such as complements, (4) the hub in the value chain in blockchain technology-based businesses, and (5) an asset retaining blockchain technology.

Blockchains can generate various complements within the context of platform leadership. This means blockchains can show the characteristics of complementarity. They bring about network externality and lock-in effect regarding platform leadership. Blockchain technology innovation is beneficial for production efficiency, cost reduction, and lowering prices.

Blockchains can also be defined as the adjustment of existing approved transactions and derivative service providers as complementors. Blockchain platforms should promote the blockchain ecosystem for platform leaders and complementors so that ecosystem stakeholders can form competitive and cooperative relationships with blockchain platform leaders.

14.1 Introduction

Who has the highest company value in the high technology industry? What are the strategic competitive advantages for industry leaders? Do they their own advantageous platforms? How do their platforms have an effect on their business transformation through the introduction of blockchain technology?

Nowadays, there is an ever-expanding number of new technologies, products, and increasing customer demands across many industries. Specifically, the current

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industry situation tells us that platform strategy is one of the key determinants of success for today's high technology companies. Many leaders in major industries are trying to apply blockchain technology to their new innovative business models as a growth strategy. For this, we need to consider how business models based on blockchain technology should be interpreted regarding competitiveness, profitability, and growth within the context of platform strategy.

Recently, blockchain technology as an industry platform has started to be discussed by several researchers. From the perspective of platform strategy, Cusumano and Gawer (2002) proposed that the scope of the firm, external relationships with complementors, internal organization, and platform technology are key determinants of platform leadership. This industry platform strategy shows the complementarity of how the marginal profit of an activity is impacted by other assets and activities. Complementors, such as customers, suppliers, and alliance partners (Cusumano & Gawer, 2002), participate in the market cooperatively and are the subjects producing the complements (Turnbull & Djoundourian, 2003; Kubartz, Lu, & Roeder, 2001; Tiwana, 2008).

Very few studies on the blockchain technology platform have been conducted, as it is a new paradigm for business transformation in the leading industries. Therefore, I intend to discuss the blockchain technology platform from the perspective of platform leadership for the above antecedents in major leading industries, such as finance, energy, healthcare, and media entertainment.

14.2 Platform Leadership

14.2.1 Definition of Platform

Shrinking product life cycles, increasing competition, rapidly changing technologies, and changing customer needs are the forces driving innovative technology transformation. Nowadays, I consider platforms to be key to the development of new business models in the era of the fourth Industrial Revolution.

Halman, Hofer, and van Vuuren (2003) described a platform as the common basis of all individual products within a product family. McGrath (1995) explained it as a set of subsystems and interfaces that form a common structure from which a stream of related products can be developed and produced efficiently. Baldwin and Clark (1997) defined a platform as follows: (1) modular architecture, (2) the interfaces (the scheme by which the modules interact and communicate), and (3) the standards (the design rules to which the modules conform). Krishnan and Gupta (2001) described a platform as a component and subsystem asset shared across family products. Robertson and Ulrich (1998) also explained it as an intellectual and material asset shared across family products. Economides and Katsamakas (2006) researched a technology platform as the hub of the value chain in the technology industry in Microsoft Windows, Intel processors, and the Sony PlayStation.

Based on these studies, I would like to define a platform in this research as (1) a firm's core asset, (2) a common basic asset within the firm, (3) an asset possibly generating derivative complements, (4) the hub in the value chain in blockchain technology-based businesses, and (5) an asset retaining blockchain technology.

Establishing a competitive platform strategy generates benefits, such as (1) multiple interfaces with end-users, (2) the lock-in (Hayes, 2007; Witt, 1997; Zauberman, 2003) of customers and stakeholders, (3) network externality (Kim, 2002; Srinivasan, Lilien, & Rangaswamy, 2004; Chun & Hahn, 2008; Wang, Lo, & Fang, 2008; Kikuchi, 2007), and (4) the keystone advantage (Iansiti, 2007; Iansiti & Levien, 2004).

Meyer and Lehnerd (1997) proposed a framework for product family development. This framework represents a single product with a product platform followed by derivative product development. The alternative is to express a non-monopolithic or modular approach to platform development. The principle of a product platform is that a new platform should have the capability to address new markets that may provide new business opportunities. The fourth principle of a product platform is that common product architecture, subsystems, and interfaces all have deeper insights, technologies, and processes that are the crown jewels of the corporation. The last principle of a product platform is that a single platform product family is advantageous for simplicity but may lose its market share in high-end market niches or waste capital investment in low-end niches (Dai & Scott, 2004). Multiple platform designs offer opportunities to generate more efficient and effective product families.

Some people are confused about the difference between a product and a platform. From the perspective of consumers' purchasing behaviors, consumers make their purchase decisions based on the intrinsic value of the product to them. However, consumers also make platform purchase decisions based on the size of the installed base and the availability of network externalities. They are mainly interested in how many other people are likely to buy the platform.

From a corporate strategic perspective, the factors that drive industry competition are customers, suppliers, substitutes, and potential entrants. The word of complementary is defined as the marginal profit of an activity that is impacted by other assets and activities. That is, these two activities are complementary when the marginal profit of an activity is increased by other increased activities. Complementors, such as customers, suppliers, and alliance partners (Cusumano & Gawer, 2002), participate in the market cooperatively and are the subjects producing the complements (Kubartz et al. 2001; Tiwana, 2008).

A platform can be characterized by uniqueness and complementarity. Like product lifecycle, platform lifecycle is composed of embryonic, growing, mature, and declining stages. As a platform evolves from the embryonic stage to the maturity stage, its complementarity becomes increasingly important compared to the uniqueness of becoming less important (Ku, 2010b).

14.2.2 Antecedents of Platform Leadership

Cusumano and Gawer (2002) proposed that the scope of the firm, external relationships with the complementors, internal organization, and platform technology are key determinants of platform leadership. First, the scope of the firm is defined as the adjustment of internal jobs and jobs from external complementors. For this, it is important to build capabilities that create complements. That is, product platforms require complements to create more value, and platform leaders should promote business ecosystems for platform leaders and complementors (Ku, 2010b).

Second, customers, suppliers and business partners as external cooperative stakeholders can form competitive or cooperative relationships with platform leaders. Therefore, platform leaders should build capabilities for the balance between cooperation and competition (Ku and Cho 2011).

Third, the internal organization of a platform leader is important to the resolution of internal and external conflicts. Platform leaders should resolve conflicts by organizing internally, setting the goals of internal processes, and acquiring agreements from external complementors (Ku, 2010b). Their senior executives should arbitrate when conflicts arise among company units to foster an organizational culture that encourages debate and tolerates ambiguity. Their management should understand that platforms are complex systems calling for neutral industry brokers to oversee the development of the system through external collaboration (Ku, 2010a).

There are three closely related issues that particularly concern platform leadership. First, even successful platform leaders can fall prey to problems that arise from too much of a platform-centric mentality. There are other ways to compete. Second, platform leaders can become so tied to certain technologies that they find it difficult to evolve their platforms. Evolution is often important to long-term survival. And third, there may be some confusion as to whether market leadership may build a stronger foundation for platform leadership. The determinants of organizational transformation discussed in past research studies include inter-organizational factors, such as specialty, functional differentiation, expertise, centralization, management behaviors, technologies, knowledge, financial resources, and communications, as well as external factors, such as competitiveness (Ku and Cho 2011).

14.3 Platform Leadership in a Blockchain Ecosystem

As market competition for blockchain application expands and cryptocurrency businesses based on blockchain become more critical, both a social and legal consensus will be required. Leading companies have aggressively established business strategies for blockchain. However, it is still necessary to establish the basis of transformation growth as the growth strategy of the cryptocurrency and blockchain industry.

Blockchain includes specific transaction records and distributed ledgers for certain time periods. This means that blockchain technology is just the technology itself and not the core asset. Blocks with blockchain technology would be transferred to all participants who ensure the feasibility of a transaction.

Blockchains can be approved when blocks are connected to existing ones. Participants in certain transactions can exchange values in blockchains without a third-party guarantee. For example, Bitcoin has no designated managers or owners due to using the person-to-person (P2P) as an online technology that allows customers to transfer funds from their bank account or credit card to another individual's account via the Internet or a mobile phone.

Blockchains can generate various complements from the perspective of platform leadership. This means blockchains can show the characteristics of complementarity. Blockchains can allow applied services based on distributed network infrastructure by using hash functions, digital signatures, and cryptography. These technologies can secure zero defects and credibility without a third-party guarantee by making all participants collaborate to check and keep transaction records and information based on a cooperative business structure.

Blockchains as platforms provide several benefits, such as security, credibility, cost reduction, and transparency. Since blockchains can have multiple interfaces with transaction participants based on cryptography, the transactions would be very secure and safe against hacking.

In general, as consumers are increased, product values are also increased dramatically. Products that more consumers purchase would have higher values and usefulness to other consumers, which would generate more purchasing needs. As a result, consumers are increased dramatically and are locked in by their own purchasing behaviors. This brings about network externality and the lock-in effect within the context of platform leadership. Network externality can be more critically strategic because of technology innovation. This technology innovation is beneficial for production efficiency, cost reduction, and lowering prices.

Blockchain technology can form various blockchains for transactions. If transaction participants' needs can be satisfied regarding security and transparency, they will use the blockchain approach more and more. This means transaction participants using blockchain technology would increase steeply and blockchains would generate higher values and usefulness to other potential participants. Like traditional platform leaders, such as Microsoft and Facebook, firms with blockchain technology would have the opportunity to take up a strategic position as a platform leader, too. Participants in blockchain transactions might be eventually locked in but would enjoy various complements generated by blockchain networks.

As stated earlier, Cusumano and Gawer (2002) asserted that the scope of the firm, external relationships with the complementors, internal organization, and platform technology are the determinants of platform leadership. Within the context of a blockchain ecosystem, we can think about their proposed determinates of platform leadership as forming specific transactions, various relationships with many participants, and blockchain technology.

Transactions with blockchains can be defined as the adjustment of existing approved transactions and derivative service providers as complementors. Building possibilities for the future growth is critical to creating more and varied services as complements. In other words, blockchain should promote its ecosystem for platform leaders and complementors.

Participants as customers in blockchain transactions and stakeholders in blockchain ecosystem can form competitive and cooperative relationships with blockchain platform leaders.

The internal organization of a blockchain platform leader is important to the resolution of internal and external conflicts regarding technological complementarity and security. The platform leader's management should understand that blockchain platforms are complex systems that need to be developed through external collaboration.

14.4 Platform Strategy in a Blockchain Ecosystem for Leading Industries

Various entities, such as governments, financial institutes, enterprises, and research institutes, have become interested in blockchain technologies. They are trying to apply blockchain technologies to their innovative business models from the perspective of a business platform.

Blockchain can be expected to maximize transaction efficiency, to reduce transaction time and operation costs, and to secure transaction credibility. However, whether its types are public or private, blockchain technology generally shows certain limitations in applications. As we have seen through several cases of hacked cryptocurrency exchanges, a business platform operation based on blockchain technology can produce any kind of security risk that can then be directly connected to business competitiveness, such as leaks of business secrets.

There are three perspectives that show what possibilities can be created through the application of blockchain technology to business platforms. First, regarding information security, even though a blockchain is a digitally distributed and decentralized ledger, increased information distribution and management channels bring about the increased probability of information leakage. Therefore, blockchain networks should be established to minimize risk. Approved users can participate and information access and distribution should be differentiated by the user. Blockchain networks can also reduce the risk of information hacking in network formation by minimizing unnecessary information sharing.

The second perspective concerns market regulation. To defend against speculative forces in a cryptocurrency market that has been growing very steadily since the end of 2017, governments could strengthen relevant regulations on security measures like real-name transaction systems and transaction certifications. For example, many governments approved an ICO (initial coin offering) to attract more investors with more innovative business models.

Third, blockchain technology can create more value in various markets. Recently, many firms have been attempting reckless business launches in unclear market situations; as a result, traditional core businesses could be harmful to the reinvestment and growth of these new businesses. Therefore, new businesses using blockchain technology should be targeting specific attractive markets through a staged approach. This can be related to strategic ideation, screening alternatives, and strategic decision-making that considers revenue model, cost reduction, and process improvement. It is important to generate ideas and find the potential in the processes of purchasing, production, distribution, and sales. It is also necessary for new businesses to find specific areas connected to the application and implementation of blockchains from the perspective of digital convergence of big data, artificial intelligence (AI), and cloud technologies. For example, Samsung has been trying to operate and manage business efficiency through Nexledger, which is a platform based on blockchain technology that is used to integrate the management of financial affiliates.

14.4.1 Healthcare Industry

Data in healthcare can be collected and generated through well-defined information processes and subjective symptoms. These include objective signs, blood test results from a clinical pathology lab, X-ray photos from the department of radiology, and histopathological opinions from the department of anatomy.

A medical information system (MIS) is the systematic management process that collects and systemizes data and makes a medical decision. Current medical information systems include a hospital information system (HIS), nursing information system (NIS), financial information system (FIS), laboratory information system (LIS), clinical information system (CIS), pharmacy information system (PIS), picture archiving and communicating system (PACS), radiology information system (RIS), order communication system (OCS), electronic medical record (EMR), and wide area medical information system (WAMIS).

As blocks with indigenous identifications (IDs) and relevant data and information are obtained, a medical information system can be built on a timeline. Medical treatment data can be secure because one doctor cannot treat and diagnose multiple patients simultaneously.

Healthcare information management should be safe and secure. Current blockchain-based medical information systems should be converged with various innovative technologies, such as artificial intelligence (AI), to defend against intelligent hacking and to forecast future changes in technological circumstances.

Blockchains with medical information as the platform can be approved when blocks are connected to existing medical information systems. Doctors and patients in medical service transactions can exchange values in blockchains without third parties.

Medical blockchains as platforms are required to generate various content and services as complements. Blockchain technology in healthcare can secure credibility without a third-party guarantee by requiring all stakeholders to collaborate to check and keep medical records and information based on a cooperative healthcare business structure.

As hospitals can provide secure and credible services and information through the various medical information systems listed above, they can lock in patients by enjoying a network externality effect. In other words, if patients can be satisfied with their needs regarding private medical records, more patients will use healthcare services based on a blockchain approach.

14.4.2 Energy Industry

Energy blockchain technology can create added value through the efficiency of energy demand control in a transparent energy transaction system. It can also reduce transaction costs by automatically transacting between suppliers and buyers and can make transactions transparent by sharing transaction information in distributed ledgers. Different types of energy blockchains include the use of electric vehicles for energy transactions, the data application of charging energy, energy sharing, and carbon trading.

A best practice energy blockchain exists in the Brooklyn Microgrid Project. Smart meters can store transactions and production data of real-time electric power in blocks and then transact that data automatically among neighbors. Brooklyn residents can locate houses that are electric power suppliers and use mobile applications to look for spaces to install solar panels.

LO3 Energy, a blockchain service provider for the Brooklyn Microgrid Project, generates energy transaction fees and sales revenues for smart meters. The company also generates operating revenues for regional energy and for the designing, purchasing, and constructing of microgrids. Energy prosumers can choose whether electric power from solar panels should be transacted as energy or kept in online and offline storage for self-use.

For the Brooklyn Microgrid Project, the smart meters with blockchains are the platforms. Smart meters provide information through mobile applications on available houses with enough electric power and solar panel spaces. One of the complementors for smart meters is LO3 Energy, a blockchain service provider.

Another example is M-PAYG, which is a solar energy generation system with blockchain technology. African people who do not have solar generation facilities can consume electric power by sharing solar generation facilities for certain periods through mobile payment technology and blockchain technology. Consumers pay monthly charges through mobile applications and then use electricity from the solar energy facilities. As consumers increase payment records, they will gain access to better medical insurance and education programs and their financial credit will improve. This service could also be applied to the agricultural industry.

14.4.3 Media Industry

Content developers in the media and entertainment industry are trying to register ownership and property rights for media and entertainment content creatures to earn fees from content users. However, they have complaints about the protection of and reasonable benefits for their intangible assets due to the inefficient management of content management agencies and service providers.

For example, content developers can utilize blockchain technology in content transactions, the analysis of content buying behavior, ticketing systems, complementary revenue sharing, and the certification of digital media sources.

SingularDTV is a blockchain entertainment studio that is a centrally organized distributed entity. They built a complete ecosystem, including a transactional video on demand portal, by providing creator-focused studios and dealing in SingularDTV coins based on Ethereum. Many participating indie artists manage all kinds of works, from project funding to distribution. Singers induce cryptocurrency funding and share profits from concerts with their fans. Recently, many pop artists have been trying to build similar platforms because they expect a virtuous cycle that produces qualified content through these kinds of platforms.

Cappasity is an immersive and experiential shopping marketplace that creates, rents, and sells AR/VR (augmented reality/virtual reality) content based on blockchain technology. Respective content files are assigned with identification numbers or hashtags to protect copyrights. Fees are not imposed on sellers or ecosystem participants. The Cappasity ecosystem expects to make 3D content providers grow to be more qualified and competitive.

Matryx is a kind of platform that resolves critical problems through VR and blockchain cooperation and is used to encourage innovative areas, such as science, technology, engineering, and mathematics. Through this platform, scientists can apply VR systems, designed virtually on a nanoscale, and experiment with practical simulation. This entertainment metaverse establishes VR/AR studios and produces branded content for CEEK partners, entertainers, and users. The Metaverse means virtual realities and transcendence, and three Matryxes include information, college, or private enterprise. Matryx offers prizes via their platform, where users submit solutions using VR tools to craft their responses. Users solve critical problems through collaboration and obtain rewards by sharing their results in the Matryx library and marketplace.

CryptoKitties is a blockchain-based game similar to Tamagotchi, where the goal is to raise a pet. All transactions in this game use Ethereum. These transactions authorize intrinsic attributes in the cat and provide opportunities for the cats to breed rare species through hybridization. Members input ether to pay the hybridization costs of their own cats and try to hybridize other cats with their cats in the marketplace. The price for the hybridized cat is decided based on the rarity of the Cattributes, and the cooldown speed for these cats can be anywhere from a minute to a week depending on the number of mating attempts. There are no identical characters in CryptoKitties. Moreover, CryptoKitties can create cats that look like celebrities.

Civil is a news platform based on blockchain technology and the open marketplace that exists for journalists and readers. P2P transactions can be realized in this liberal newsroom that is against advertiser influence, political pressure, and censorship. It can be operated in a decentralized and autonomous organization with five participating groups, such as a journalism advisory committee, managers, news producers, citizens, and fact checkers.

Steemit is a social network platform that provides rewards. Users post stories and pictures on the Steemit blog and gain rewards via cryptocurrency for any upvoting over a seven-day posting period. Steemit distributes three cryptocurrencies: Steem, Steem Power, and Steem Dollar. Steem is the major cryptocurrency and basic token in Steemit. Steem Power is the cryptocurrency that is influenced by content voting by bloggers. Steem Dollar is a kind of derivative product that provides a 10% interest rate for a year and is exchangeable with Bitcoin.

14.5 Conclusion

Blockchain technology has been continuously upgraded over time. This technology does not focus data in one area, shares all transaction data in all connected networks, and codes transaction data. Blockchain can be applied to increase the transparency of transactions and to increase the security of platform operations and applications. It can also be used in almost any industry that requires credit or reduces inefficient parts to attain a fair distribution of profits.

For example, the media industry can apply blockchain technology to entertainment, games, VR/AR services, journalism, and blogs. However, blockchain technology is not for technology itself any longer. Various kinds of business models should be implemented using blockchain technology so participants can participate in more transparent and secure transactions.

As network participants are correlated with each other in a more complex and staged manner, they cannot increase the possibility of sharing information among stakeholders to make smarter contracts.

The process of transferring content or information to consumers requires many steps: copyright protection, funding, production and profit sharing, distribution, advertising, and consumer participation. Due to the many complexities involved in blockchain technology processes, a newly converged research area, called the CryptoEconomy, was created and has been combined with security technology through distribution networks and economics.

From the perspective of platform leadership, the blockchain platform strategy has a critical effect on firm performance by network externality and lock-in. This chapter made contributions as one of new researches on platform strategy and leadership in a blockchain ecosystem. The direct effect of the complementarity of a blockchain platform sheds new light on the importance ascribed to the concept of a blockchain ecosystem.

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Chapter 15
Blending Business Strategies with IT in Digital Era

İlker Met, Ertuğrul Umut Uysal, and Esra Orç

Abstract The alignment of IT management and business is the key factor for the success of enterprises. The IT management must take care and understand the business strategies and proceed in this context for the management of data, application and the infrastructure architecture. The business must also implement methods to transfer the logic behind the strategies, vision, organization, the processes to improve and the functions to develop to the IT management in a context of business architecture. Throughout blending business strategies with IT management, the enterprises can achieve more efficient business and IT operations, better return, reduced risk and complexity; so, the organization becomes more agile among different distribution channels, project and change management is easier and the software development costs will be lower.

15.1 Introduction

In order to adapt to the ever changing and evolving conditions, every business regularly reviews its priorities and many important strategic decisions are taken. As of these decisions, the feasibilities are evaluated and the projects are carried out. But while the projects are going on it is recognized that some issues could not be adequately predicted before. Sometimes another strategic decision is taken or a new legal regulation that takes effect turns the selected path into a dead end street. Sometimes a sudden another outer effect, like a technological development changes the strategic decision. The result, unfortunately, is a new addition to the set of decisions that are shadowed.

At an enterprise where blending IT and business strategies within long term planning becomes increasingly difficult there is a need to implement an effective approach. This approach must support the enterprise with the necessary flexibility

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and analysis capability to adapt to changing conditions. In this article, the details of our enterprise architecture management approach that can be applied successfully and that can eliminate the problems mentioned above will be discussed.

Within our enterprise architecture management approach, the enterprise must model the current IT (data, application, and infrastructure) and the business architecture relations. The targeted IT and business architecture is determined by blending IT and business strategies. So, all the teams at both IT and business must work in a harmony to achieve the desired target. The meaning of digitalization for the enterprise must be same for all the stakeholders as of channels, products and the operations. New technologies may affect the targeted architecture. The management of the interactions between parties and the project portfolio management is important. The agility of the software development must become widespread. The process improvement team must have good communication and take care for user experience studies. These studies may include online or face to face customer journey testing. Digital process improvement, robotic process automation and artificial intelligence may be in the scope. The IT risk management team must manage risks at the transition period to the target architecture.

15.2 Today's World

Nowadays, most of the technologies accepted as digital technology are being used extensively in many areas of economic and social life.

This transformation, today called the Industrial Revolution 4.0 or Digital Transformation, is mainly through the use of digital technologies and products, such as big data and advanced analytics, artificial intelligence, autonomous robots, cloud computing, increased and virtual reality, internet of things (IoT), cyber security. It has a wide impact in all areas of life, from industry to agriculture, from banking to health, from transportation to public services.

The rapid increase in the usage rates of digital technologies has been explained with the benefits of technological developments and deepening and spreading of usage areas and decreases in software development and hardware costs. In recent years, the complementary and combinatorial features of digital technologies have been strengthened, and their benefits have begun to increase rapidly. For example, when combined with big data, advanced analytics and cloud computing technologies, a greater benefit is generated from the sum of the economic and social that both technology groups create on their own.

This situation positions the digitalization process in a different period from the previous technological breakthroughs. While technological progress is one of the main drivers of the digitalization process, it will be a narrow perspective to consider the digitalization process only as the development and use of digital technologies. Industry Revolution 4.0 may be called as the digitalization of the industry. However, this may only be considered in the organizational of all working and processes of a company, not only an operation of the production line.

The process of digitalization is a process in which industrialists, employees, universities, and the public are transformed and include new business models and ways of doing business. In addition to traditional players, digital platform players also share the value created in many sectors. This orientation shows that the traditional way of creating value changes and that the created value is shared in different ways.

The enterprises aim to develop and implement effective policies by analyzing the global developments and their dynamics. When technology intersects real world; in the innovation ecosystem, all stakeholders need to be in efficient and coordinated collaborations to manage the team play well. In this respect, new forms of doing business show up.

In order to realize a strong, sustainable and balanced digital transformation, strategies and policies should be adopted to ensure efficiency, quality, speed and flexibility in line with the corporate objectives.

After all; strategy, not technology, drives digital transformation (Kane et. al. 2015).

15.3 Why Enterprise Architecture Exists?

Adapting to transformation in terms of changing customer needs with continuously developing technology is a skill that is expected to make a difference for all organizational structures. In today's world where change and transformation are inevitable, disruptive forces are attacking to organizations in every way. Those who understand the meaning at transformation will survive in the future.

Big or small changes that are difficult to predict make each day more unstable. The complete unexpected emergence of change, the *Volatility* of the cause-and-effect relationship makes things harder for leaders. Historical estimates and past experiences no longer have their interest and rarely apply to predict the shape of futures. The *Uncertainty* of how the course will be is affecting investment, development and growth plans. Because of the new world's *Complexity*, problems and their responses are more layered. The intermingling of different layers makes it difficult to get an overview of how events are related. Decisions are reduced to a mixed reaction network and counter-reaction—and it is almost impossible to choose the right path. It is rare to interpret the events completely clearly or precisely. In the world of *Ambiguity*, not everything is black and white—gray is also an option. "One size fits all" was left out; "tailor made" method is adopted anymore. Modern organizations and management demands are more paradoxical than ever. Deciding now requires courage, awareness and willingness to make mistakes.

Enterprise architecture governance is the navigation tool for leaders in this *VUCA World* (Giles, 2018; Glaeser, 2019).

In order to efficiently operate the digital transformation process, enterprises need to transform their management concepts, organizational structures and business cultures as well as the technologies they use in their production processes. The transformation process in our enterprises should be primarily owned by the senior management and the organizational structure should be reviewed to enable the digital transformation to take place. In addition, innovation culture should be developed in enterprises for possible resistance to change.

Digital is not just something you can buy and install to the organization. It is versatile, common and does not include only technology. Digital transformation is a process that continues to change the way you do business. It requires basic investments in corporates' capabilities, projects, and infrastructure also often in the cleaning of IT systems. For this, it needs mixing people, machines, and business processes, with all of the messiness that entails. It also requires constant monitoring and intervention from the outset to ensure that both digital leaders and non-digital leaders make good decisions about their transformation efforts (Davenport & Westerman, 2018).

The organizational processes and customer service model should have the flexibility and agility to keep pace with the needs and technological developments. For this, companies need to be able to get the signals of opportunity and threat as soon as possible, to fully reveal their effects and to take action quickly by identifying the actions to be taken. Monitoring all interactions between the components of the organization's skeleton to see all possible effects, will guide the corporations in the strategic decision-making process.

A management approach has been developed to address this complexity in accordance with the organization's own management model within standards.

This approach, *Enterprise Architecture Governance*, is the organizational management logic for business processes and technology that reflects the integration and standardization requirements of an organization's operating model.

The function of Enterprise Architecture is to guide and assist IT projects, thus ensuring the reliability, interoperability and sustainability of technology, information, infrastructure and business processes.

15.4 Definition of Enterprise Architecture

The concept of Enterprise Architecture was introduced to address these basic problems: Complexity of systems and failure of IT compliance with business.

It had to be solved that spending a lot of money on complex systems, and the difficulty of understanding the language of IT. This concept had to be drawn as a framework and worked with a methodology. The basic components of this concept were Enterprise and Architecture.

Enterprise is the structure of organizations with common goals.

These organizations may be government departments, group companies, a company or only one department. In view of the developing business world, enterprises now include suppliers, business partners and customers.

Architecture, on the other hand, is the art of designing any structure in a measured way according to the rules. It is derived from "arche" (principle and priority) and "tecton" (craftsman) roots in Latin.

So, *Enterprise Architecture (EA)* is an ecosystem that manages the relationship between business and information systems within the framework of the targets and strategies determined by the company and direct the technology to be used in the enterprises. Similarly, there are many common features between EA governance and the architecture (total concept) of a building (structure).

15.5 The History of EA

The history of EA was started in 1987 by J. A. Zachman with the publication of "A Framework for Information Systems Architecture" in IBM Systems Journal. In these documents, Zachman explained the vision of the enterprise architecture and the road map on the basis of next years and aimed to solve the increasing confusion in the decentralized systems. As Zachman said: "The cost involved and the success of the business depending increasingly on its information systems require a disciplined approach to the management of those systems."

Zachman's vision was that business value and agility could be accomplished through a holistic approach to the system architecture that clearly dealt with every important issue from every major perspective. The multiple points of view to architect systems is what Zachman defines as an information system (Sessions, 2007).

The Zachman framework had a significant impact on the initial attempt to create enterprise architecture structure by a branch of the U.S. Government, the Department of Defense (DoD). This attempt was known as the Technical Architecture Framework for Information Management (TAFIM, Department of Defense Architecture Framework) and was introduced in 1994.

In the 1990s, DoD also developed a framework to manage large systems with complex integration and interoperability challenges, and it is apparently unique in its employment of operational views. The Department of Defense Architecture Framework (DoDAF) is under the name C4ISR (Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance) Architecture Framework. It had been evolved in the same period the reference model TAFIM was further developed. TAFIM also attracted attention by the US Congress, where enterprise architectural methods could align commercial needs with their technical projects. Then, in 1996, the Information Technology Management Reform Act was issued, which is required all federal agencies to take steps to improve IT investment efficiency. With this law, a council was formed with CIO level participants from all governmental parts. The output of this council in 1999 was the Federal Enterprise Architecture Framework (FEAF), which included some innovative ideas such as "structured architectures" focusing on subsets of large organizations. FEAF provides a common language and framework to describe and analyze IT investments, enhance collaboration and, ultimately, transform the Federal government into a citizen-centered, results-oriented, and market-based organization. Over time, the low rate of use and confusion of this framework led to the inability of large institutions to be implemented (Urbaczewski & Mrdalj, 2006; Basten & Brons, 2012).

In 1998, TAFIM was officially retired by the DoD. The work done on TAFIM was turned over to The Open Group Architecture Framework (TOGAF). In 1995, the original development first version of TOGAF was based on the TAFIM. The DoD gave The Open Group explicit permission and encouragement to create TOGAF standard by building on the TAFIM, which itself was the result of many years of development effort. The TOGAF standard is developed and maintained by members of The Open Group, working within the Architecture Forum (TOGAF 9.2, 2018).

TOGAF advocates and uses a systematic methodology based on other frameworks. The organizations and individuals are free to reach and use TOGAF. So you can bring it to life, making your own design according to your organization that you want. Using TOGAF system, it will be able to obtain results in harmony with building blocks.

Although TOGAF does not recognize itself as a framework, TOGAF is actually an Architectural Development Method (ADM). ADM is a prescription of building architecture. Prescriptions can be classified as processes. As an architectural process, Zachman tells you how to classify structures; TOGAF completes Zachman and offers you the process of creating classes (Fig. 15.1).

EA that started with the public sector began to show its popularity in the private sector in time, too. Also, the private sector has started to take a share in order to carry this structure to benefit all corporations. There have also been other frameworks developed over time.

Main frameworks are (Basten & Brons, 2012)

- Zachman Framework (1987)
- TAFIM (Technical Architecture Framework for Information Management) (1994)
- DoDAF (The US Department of Defense Architecture Framework) (1995)
- TOGAF (The Open Group Architectural Framework) (1995)
- FEAF (Federal Enterprise Architecture Framework) (1996)
- IAF (Integrated Architecture Framework) (1996)
- ARIS (Architecture of Integrated Information Systems) Framework (1990s)
- OBASHI (Organization, Business, Application, System, Hardware and Infrastructure) Business & IT Methodology and Framework (2001)
- ArchiMate (Architecture-Animate) Architectural Framework (2004)
- Gartner EA Methodology (2004)
- SAP Enterprise Architecture Framework (2007)

An EA framework can be adapted to the organizations or since none of the approaches have been complete as yet, a blended approach might be a good starting point for many enterprises. These enterprises can create their own EA framework from the methodologies that provide the highest value in specific areas of concern. Ensuring governance within the frameworks specific to the organization will give the best results (Urbaczewski & Mrdalj, 2006).

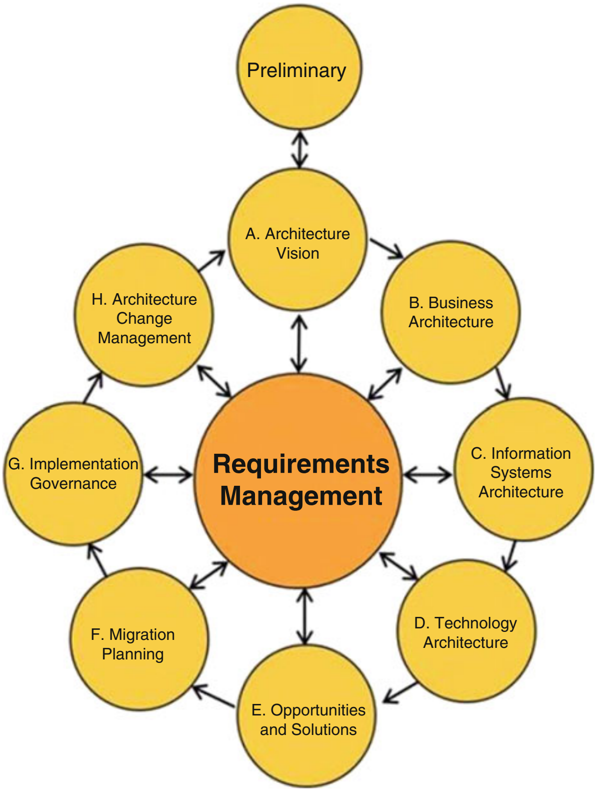


Fig. 15.1 TOGAF™ Architecture Development method (ADM) Cycle (TOGAF 9.2, 2018)

15.6 Enterprise Architecture Layers

If we compare the organization to a building, we can think that it is composed of main systems such as walls, electricity and water. It is also a different capability which is producing this building cheaply and selling it in a way that brings more profits.

Each layer's management requires different knowledge and skills. To bring these layers of the building together, different perspectives and points of view are needed. Therefore, managing your company's component layers in this way will provide the same ease.

An architecture framework contains information identifying the fundamental architecture constructs and specifies concerns, stakeholders, viewpoints, model kinds, practice rules and conditions of applicability. While an architectural framework is needed to discover, define, and organize interests related to the system at hand, architectural representation is used to clarify, analyze and resolve these concerns.

As it is known, a system has various stakeholders. They receive or provide data from the system in accordance with the concerns and perspectives of the stakeholders.

This structure is called the "view" and "viewpoints" in the TOGAF methodology.

The viewpoint is used to define the position that the stakeholder must look for the elements that are related to his/her responsibility. View is defined as what they see when they look at the point that provides the point of view of the stakeholder, and they are usually used with the specific format called the model type in the architectural language.

It is possible to define the EA as a whole of the processes, models, principles and principles used in the design and development of the software and IT infrastructure. An architectural structure is a set of building blocks. The building blocks are defined by the models that form within the viewpoints and views.

EA domains (layers) are:

1. *Business Architecture:* Identify the processes that business units will implement to achieve their objectives.
2. *Information/Data Architecture:* Determines how enterprise data sources are organized and how to access them.
3. *Application Architecture:* Identify the applications needed in the organization and their relations with each other.
4. *Technology/Infrastructure Architecture:* Determines how hardware and software infrastructure should be supported to support applications and relationships (Fig. 15.2).

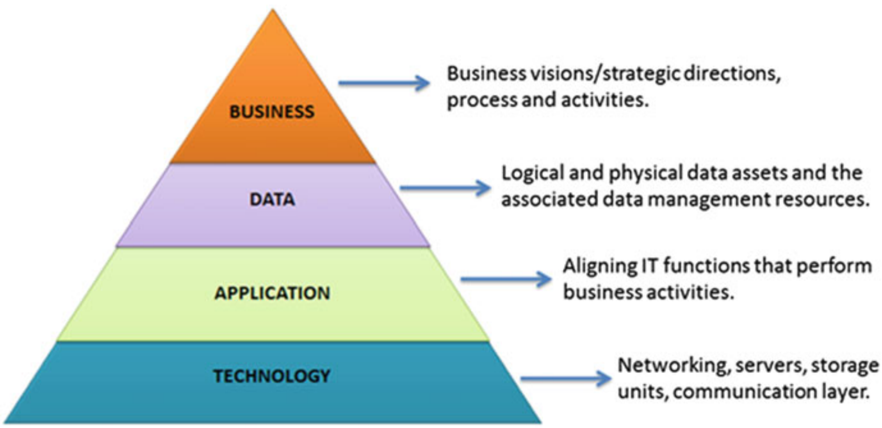


Fig. 15.2 Enterprise Architecture Domains

15.6.1 Business Architecture

The use of enterprise architectural models in the global has been initiated in order to model the inter-technology relations and thus to effectively manage the interactions between the company's applications and technology infrastructures. Over the time it has been developed by incorporating the business architecture into the model.

It is the layer where all business activities are modeled in order to manage the organization's current, future and changing activities and competencies. As-is process models are transferred to to-be process models which show the future business process flow.

It is a description of the structure and interaction between the business strategy, organization, functions, business processes, and information needs. Relationships between these elements determine what the organization does and what it should do to meet its strategic business objectives and priorities.

The standards and processes of the enterprise architecture program will be critical factors in which the vision and strategic direction of organizations, business objectives and priorities will be transformed into effective technology developments across the organization. The strategic priorities, the focus of the organization and point of view have to be shared with all stakeholders in order to take action. In order to carry out the necessary studies within the strategy portfolio, relevant departments should be in constant communication with each other.

Business architecture governance can clearly show how an organization is formulated and how elements such as capabilities, processes, organizational roles and information fit together.

Business Capability Modeling is a technique used to represent an organization's business model independently of the organization's structure, processes, personality or domains. It focuses on the ability of the organization to strive to maximize the business value of architectural decisions.

15.6.2 Data Architecture

Data architecture describes the structure of an organization's logical and physical data assets and the associated data management resources. It is definition of the major kinds of data needed to support the business. In general terms, the production of data, processing, storage, sharing, securing, backing up, is intended to be associated with other modules. Data architecture manages the activities required to obtain and maintain data that supports the information needed by the corporation's major business areas.

Data and information are different concepts. Data is the foundation of information. Data is processed and refined raw material to produce information. The information consists of the collection of relevant data processed in a meaningful form for the recipient (Davis & Olson, 1985). Data lifecycle management manages how to create, classify, update, use, distribute, and archive data and information.

15.6.3 Application Architecture

In the business world where intensive technology is used, aligning IT functions that perform business activities gives companies greater flexibility in managing changes.

The list of available applications, the features they have, the technologies they use, the resources that support the applications, the hardware and features they run on, the other applications or services they exchange data, and the updates that need to be made according to the new requirements are made in this step. In addition, other catalogs are prepared by subtracting the application topology.

Business architecture and IT architecture relationships are created by determining the aspects of the business interaction with the applications which business functions work on. In this way, business capabilities, business functions and other applications that will be affected by the change in an application can be determined and appropriate actions can be taken. By introducing all the interactions of the application architecture and establishing relations with the business architecture, actions are taken to consolidate the different applications that serve the similar business functions, thus achieving significant gains in application development and maintenance costs.

15.6.4 Technology Architecture

It is the layer in which logical and physical technology components are associated with the application components of infrastructure platforms. Networking, infrastructure elements, servers, storage units, communication layer, the technologies used in the network and the improvements that need to be made with new technologies are emphasized.

IT support platforms are managed, including products belonging to third-party companies, which run the logical technology portfolio, all applications that serve the business capabilities. Architectural components, platforms and standards of logical technology that will develop or change will be modeled under this domain. The applications and technology life cycle of all the hardware running applications on are managed here.

15.7 Enterprise Architecture Team Players and Their Tasks

When creating the EA governance, there are positions that will fulfill these tasks. The qualifications required for job descriptions and governance can be listed in Table 15.1.

Table 15.1 Architectural positions and tasks

Architectural team	Tasks/functions
Business architects	They are teams that design and model business processes and capabilities. They are responsible for keeping the information in the EA tool up-to-date by following the newly implemented or canceled business functions in the organization. These roles are not usually part of the IT department. They design the future-desired to-be models of the process flows. They may be the part of the user experience team in the enterprise.
Data architects	They are responsible for setting policies, standards, and ensuring that data are modeled on a logical level. They conduct studies such as data quality and data profiling. Data architects are responsible for determining the data used in business processes, archiving and deleting data when necessary, and establishing application connections in such a way as to take actions.
Application architects	The most basic tasks of the application architecture team are; – Establishment and maintenance of application portfolio, implementation strategy and determination of applications to be retired, – Understanding which applications are used in business processes and using the business process effectively and efficiently and work closely with business architects to understand their to-be process models. – Ensuring that applications come to live environments integrated with common applications such as performance monitoring, authorization and logging, – Positioning the applications to be purchased or developed within the architectural structure, determining the integration points with other applications, – Defining the applications and the integrations between them in conceptual/logical basis in application development projects and identifying the services to be developed and manage their life cycle.
Technology architects	It is seen as the teams that draw the models of infrastructure systems, determine the rules of standards and determine the future architecture, which are included in the projects. Senior experts and managers in infrastructure teams perform this function as part of their responsibilities.
Solution architects	They create design solutions that will ensure that the business requirements of projects with high strategic and business impact on technology architectures are compatible with the application and technology architectural requirements. After the projects are completed, business and IT solution architects prepare project closing reports and conduct committee presentations in order to analyze whether the objectives at the beginning of the project have been achieved or how much has been achieved.

15.8 Integration of Architectural Processes into the Way of Doing Business

Enterprise architects use various methods, analytical techniques and conceptual tools to understand and document an enterprise's structure and dynamics. In doing so, it is produced catalogues, drawings, documents and models that are collectively called artefacts. These artefacts describe the logical organization of business functions, the business capabilities, business processes, people, information resources, business systems, software applications, computing capabilities, information exchange and the communications infrastructure within the enterprise. EA practitioners consider a collection of artefacts sufficiently complete to describe an enterprise in useful ways as constituting an EA model. EA models illustrate architecture descriptions. Briefly, it is provided to represent the different views of the architecture with EA models (Melão & Pidd, 2000).

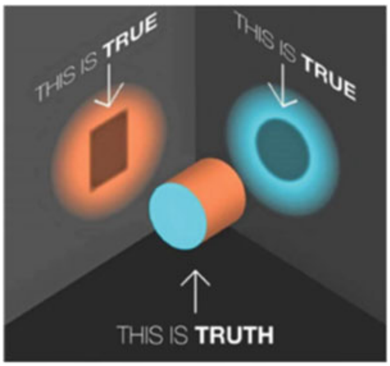
It is necessary to create a team that will assure enterprise architecture governance. This team should be carried out with a focus on bringing together work, business and IT teams. In this context, it is also important to establish an organization that will run the enterprise architecture approach in the organization, determine the policies and implement them into the processes. Identifying, offering and presenting architectural services to meet the needs of all stakeholders is one of the tasks of the EA team to meet both IT and business demands. This team will organize different stakeholders, such as project management, business departments, IT teams, risk units, senior management offices, in better cooperation with different perspectives.

A system is a collection of components that are organized to fulfill a specific function or set of functions. It is useful to consider an architecture framework in this context to include a collection of architecture representations which are *views* and *viewpoints*.

We understand and communicate the truth and the future with our viewpoints and related visions determined by our role/interest (Fig. 15.3).

A viewpoint is a set of agreements that include specific systemic concerns, definitions and analyzes. A concern can be framed by more than one viewpoint. The term concern refers to any area of interest to the system. More than one stakeholder can have the same interest in the organization. A stakeholder can be individual, team, organization or classes thereof, having an interest in a concern and by extension an interest in the viewpoint and system. Modeling structures can be defined as model kinds, which are constructed from each viewpoint to identify concerns, analyze, resolve and to see their links between all stakeholders. The architectural framework can be considered as the whole of the types of models identified by the associated stakeholders, their viewpoints and common concerns.

Fig. 15.3 True vs. truth



Different concerns create different viewpoints. Approaches to the definition, analysis and resolution of concerns seen in these perspectives, constitute architectural views. Architectural models are created in the solution of the architectural concerns which are aimed at each viewpoint. Thus, architectural views and architectural models can be defined as the representation of the architecture.

A common approach for designing and managing a complex system is to decompose it into constituent subsystems. It will be necessary to examine what other functional subsystems of this main system are and how they behave to perform their functions. Functional separation of the system, detailing the features of other subservices, redesigning and using it, will provide convenience and maintenance in different places.

The diagrams used to see the structure; the mode of interaction and the status of the subsystems indicate how one of the system or its subsystems behaves in response to internal and external events.

These diagrams and their associated documentation collectively describe and address the concerns of the functional decomposition. The component, sequence and state diagrams are said to be the model kinds for addressing the concerns of functional structure of the system. The resultant concrete models by applying these model types to system decomposition are the part of the architecture models (Lin et al., 2017).

In the essence of the meta-model is a governance map that shows how an enterprise works (Fig. 15.4).

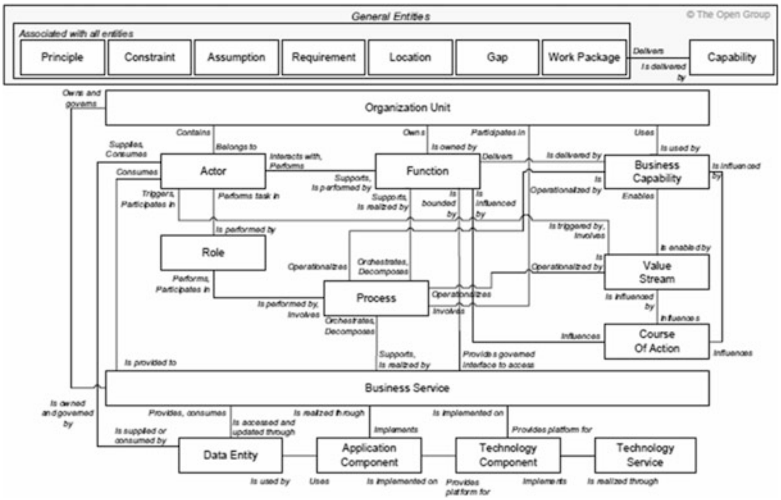


Fig. 15.4 TOGAF™ Meta-model, TOGAF 9.2, 2018

15.8.1 Business Capabilities and Functions

It is important to develop capabilities which fit for purpose. Today, “knowledge” is considered to be the most strategically valuable resource, but “learning” is the most important strategic capability for business organizations.

Although these issues are so important, most of the methods used to develop and benefit from organizational knowledge is not linked to business strategy. Even though, by the managers, it is thought that having more information will give them advantages compared to their rivals, this way of thinking which is not framed systematically will not go beyond managing information with feeling.

Technical and business initiatives, when aligned and integrated, can provide a comprehensive infrastructure to support knowledge management processes. But while the appropriate infrastructure can enhance an organization’s ability to create and exploit knowledge, it does not insure that the organization is making the best investment of its resources or that it is managing the right knowledge in the right way. How should an organization determine which efforts are appropriate, or which knowledge should be managed and developed? (Zack, 1999).

Enterprise’s strategies and priorities are the most important guides for knowledge management. An organization’s strategic context helps to identify knowledge management initiatives that support its purpose or mission, strengthen its competitive position, and create shareholder value. Thus, it makes sense that the company, which knows more about its customers, products, technologies, markets, connections and their linkages should perform better. The corporates which see the linkage between knowledge management and the business strategy will go forward.

Many managers have difficulty in identifying the relationship between their organization’s intellectual resources and capabilities and its competitive strategy. They do not have well-developed strategic models that help them to link knowledge-oriented processes, technologies and strategy documentations, and are not sure of how to translate the goal of making their organizations more intelligent into a strategic course of action.

Knowledge-based competitive superiority is also continuous because the more an enterprise knows, the more it can learn. Learning capabilities for an organization that already has a knowledge advantage may be more valuable than for competitors having similar learning opportunities but starting off knowing less.

Business capabilities are the core of the business architecture. A business capability defines “what” a business does at its core. This differs from “how” things are done or where they are done.

Designing the future will be realized by planning the model that forms the basis of enterprise architecture (Fig. 15.5).

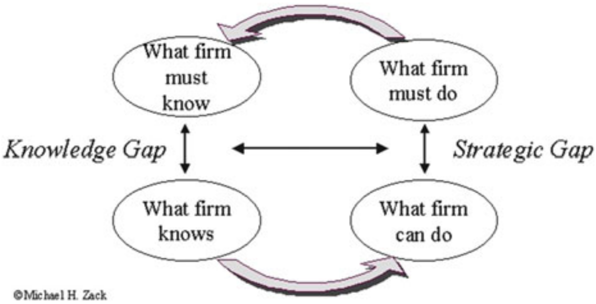


Fig. 15.5 Knowledge Gap Map (Zack, 1999)

15.8.2 Demand, Portfolio and Purchasing Management

Digitalization is the driving force for strategic portfolio management. In today's world where speed is the most important demand, digital transformation is very effective in the products and services offered to customers. Although it ensures that everything goes well and meets expectations, sometimes it can make things difficult.

Enterprise architecture aims to close the gap between business units and IT, ensure that the organization's business strategies, objectives and priorities are correctly communicated to IT and ensure that IT teams act in line with the rest of the organization and that investments and expenses are used in line with business objectives.

EA provides organizations with an advantage in achieving progress by reflecting their strategies to projects by transparent their complex business dependencies. Corporations, systems, projects and demands have become very complex. Architecture-driven project management will allow the differentiation of target and contemporary architecture to match the target architecture. It will not be logical to start any project without drawing pictures of their current and future statements. The path to the transition from the "as-is" state to the future target system "to-be" is an approach that determines the map (Fig. 15.6).

Previous investments should be continuously updated according to new technologies and changing needs. In order to do this, it is important to predict where, when and what changes should be made and to use the IT budget and resources in the most accurate way. In order to achieve this, it should be ensured that complex information systems are defined with business, application, data and technology layers and standards for change are developed.

Just investing in information technologies in the digital world is not enough to succeed. In this context, it is very important to predict where and when changes should be made and to use the IT budget and human resources in the most correct way. In this journey, it is needed to identify increasingly complex information systems with business, application, information and technical layers and develop our standards for change.

In today's transition from project management to product management, the right product has to be put on the market at the right time or opened to use according to

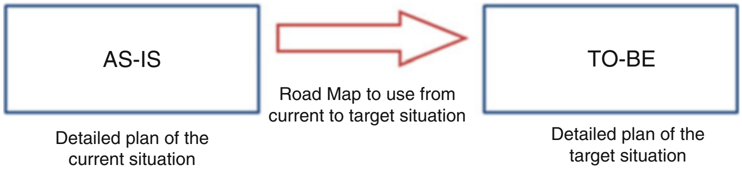


Fig. 15.6 As-is/to-be Architecture

customer needs. Product management includes the methods that should be applied to capture the needs of consumers in the simplest form or sometimes in advance and to anticipate the best possible needs.

Products born, develop, change and die. It is important to monitor the product life curve but it is more important to monitor the market life curve.

It is not possible to succeed for enterprises that do not link their business strategies with daily operations and projects. The connection can only be established with corporations' EA model.

Enterprise Architecture models can make it possible to draw a real-time and accurate picture of the IT, including the flow of all applications and technologies, the relationships between them, the business units and processes of information. From the strategy to the demand, from the demand to the project, from the project to identify the target architectures, the preparation of master plans and budget management is shed light. These projections can be accessed by establishing the correct connections between the components.

Correct reporting methods should be used to show the facts and standards in a better and improved way. Thus, with the optimization of IT investments (CAPEX) and expenditures (OPEX), and transparency in the IT environment, there is a chance that more resources can be allocated to innovation in the field of IT.

Thus, more return is received from the investment in information technologies and the risks in the transformation process are reduced (Fig. 15.7).

15.8.3 Agility

In line with the strategies, the method of realization of prioritized demands may also change. With the prior delivery of the scope of request or demand to the developer, the product at the end of the term may be very unlikely to meet the expectations. For this reason, agile development method can be adopted which includes preliminary evaluations such as determining the points which intersect with other demands and which needs will be done in line with the benefits of the business unit and IT teams.

Agile method is a cyclic process and is based on iteration. There are analysis, planning, designs, coding/engineering, testing and releasing for each new functionality feature in each cycle. Although the development of each product/project demand does not have to be done by agile method, it is aimed to deliver new

Fig. 15.7 Strategy, Capability and Portfolio Management with EA Logic

software at the end of each iteration. While planning for the next iteration, the initial planning may change, but these can be revised according to the needs priorities. Agile methods prefer face-to-face real-time communication in order to take action quickly instead of written documents. In these projects, agile teams are positioned together in the whole software development cycle.

With less effort, EA can rapidly increase the level of maturity and to spread a single system throughout the organization with the same information for different stakeholders.

15.8.4 Process Improvement

Isn't the goal of doing business in a high quality and less costly way, rather than making the user tiring and non-guiding?

Today's main trends; mobility, social applications, cloud and big data are shockingly affecting all organizations. The companies which are negligent on these issues are facing the danger of extinction. Who wants to successfully complete their digital transformation need to be able to effectively manage these trends.

Regardless of which sector you are operating in the new digital world, it is of great importance for the modern enterprises to automate the processes, to manage extraordinary situations and to observe all processes throughout the enterprise.

Processes are measurable activity groups with inputs and outputs, monitored by checkpoints, repeated in interaction with each other, creating added value for the enterprise.

With business process management (BPM), after the main business processes are determined, it is necessary to find out the sub-processes and then continuous improvement studies include the analyses of existing processes with their sub processes. Process management consists of process modeling, improvement, and regular monitoring works by setting performance indicators. Nevertheless, process management also requires processes to be regularly updated by process owners due to reasons such as; customer expectations, technological developments, operational risks, changing legislations and legal regulations, internal audit results. Process improvement activities include process redesigns, improvement of existing processes and their improvement within the framework of certain strategies. Removal of reiterated activities in unnecessary cycles without added value is also aimed.

With the process improvement effort of the business architecture, optimized cost management is provided for applications and business processes and continuous improvement is aimed. It is important to transform, evaluate, change (*Kai*) in a better (*Zen*) way. A decrease in the costs of providing a rapid but very rapid development in processes, time, and technology in order to increase customer satisfaction and influence the competitiveness in a certain period of time is *Kaizen*.

Kaizen; in the process dimension, is the protection of processes that include corrective actions and improvement of processes. In the time dimension, it is aimed to adapt the market by decreasing change costs because rapid changes occur in the market. On the other hand, in the technology dimension it is aimed to transform the technologies by simplifying applications.

Predicting where technology can be used more effectively is crucial when planning a new job definition and future investments. It is likely that new functions will be added to the processes carried out in line with the organization's job description and strategies. The process of improvement by utilizing today's technology is an investment in the future. Adding new functions to our business may also indicate that there is no need for the old ones. The establishment of the structure of the alarm systems that give us the self-awareness of the situation can be noticed by these continuous audits by being the part of the model at the enterprise architecture governance. If the architecture of the organization is not corrected, the process improvement effort cannot make enough improvements. No further improvement can be made and it has to turn to innovation when it comes to the saturation point.

15.8.5 User Experience

It cannot be expected that the product life that is not preferred to use by the end user is too long or healthy. This can create negative feedback, erroneous transactions, low rating scores, etc. For this reason, it is important to remember that one of the stakeholders that need to be taken into consideration when creating new products is the end user.

The future structure of the product should not reduce existing functionality. You can suggest different methods for performing transactions, you can use new technologies, but when you take away the tool that is necessary for the user to do the job, then there is a problem.

In this process, if you are developing a product with agile method, it is useful to take the thought of the user for the outputs obtained in the direction of iterations. This user experience tests results will be one of the biggest indicators of whether you are on the right way or not. Cleaning up unnecessary business processes can cause difficulty in giving up the old habits of the user. But when you see that the old processes have been removed in the realization of the work-related scenarios, you will be relieved and stepped in to break the resistance (Met, Erkoç, & Uysal, 2018).

Various methods can be applied to get the user's views on your development. This can be done by face-to-face or by asking online questions.

When the user is asked to perform the scenarios defined by the prototypes, methods such as numerical measurement of the answers to the survey questions can be used. These are good feedback for the re-evaluation of designs that extend the business process, if any.

15.9 Implementation of Enterprise Architectural Governance

15.9.1 What We Have Done?

In the traditional approach, a strategic decision is taken from an instant section of life. For example, the decision to enter a new investment area is evaluated from the past perspective of the enterprise and the new internal and external factors that will generally occur during the investment cannot be fully predicted within the complex world. Because in the traditional planning concept there is no interactive network design such as enterprise architecture governance. For this reason, strategic decisions can be taken without adequately addressing the contributions to processes, capabilities, the other artefacts. This results in unintended consequences such as serious inefficiencies and inability to achieve the expected goals.

An EA system can be easily created to solve the problem. The most important requirement for the adoption of an EA approach is the creation of an enterprise specific EA model. At this point, there is no only one correct, and different models can be used for each organization (Met, 2019).

The meta-model of our organization, which is designed in a flexible manner, extends from the top level vision to the bottom level technology infrastructure architecture. This meta-model is designed to serve both the companies of the whole group and to demonstrate inter-company interactions.

Our enterprise architecture meta-model is based on six main entities:

– Strategy Architecture
– Business Architecture
– Portfolio Alignment
– Data Architecture
– Application Architecture
– Technology Architecture

Strategy Architecture It adds architectural activities to IT project management processes to ensure that the individual governance of portfolios within each layer is integrated into investment decision processes. In this context, it is ensured that the business units are able to progress by determining the relevant strategic objective, business capability and business process. As a result of the elections, it is possible to report on which strategic target and which business capability it invests in terms of current period and to determine which strategic target and business capability to invest in the future. In addition, this flow which of all steps are managed by architects, serves us to see the unseen, complete the deficiencies and make proactive decisions.

Business Architecture Governance It is the model where all business processes are modeled to ensure the management of existing, future and changing activities and competencies. All the variables that affect the way of doing business are included in the model by including business capabilities, business functions, processes, channels, environment, organizational units, group companies, products, customer segments, location model as components.

Portfolio Alignment When strategic goals and existing business capabilities are associated, information can be set on which capabilities the enterprise needs/needs to be finalized in order to achieve the desired point in the future. For this purpose, it is necessary to know that the right capability is invested. Portfolio alignment is beneficial in project prioritization, while generating earnings.

Data Architecture The way to use all methods, techniques, and maps is related to the management of data. Which data are kept, who is the owner of the data and how much data should be stored, who should decide to delete the data, how much data should we allow for transfer, how to ensure security and archiving, etc. Components and interactions that answer these questions are managed in our meta-model by keeping all data up-to-date.

Application Architecture Business and IT architecture relations have been established by revealing the interaction aspects of the applications and applications those work functions. In this way, business capabilities, business functions and other applications that will be affected by the change in an application can be determined and appropriate actions can be taken. It is ensured that actions are taken to consolidate the different applications that serve the business functions of a similar nature through the establishment of relations with the architecture and the establishment of relations with the business architecture. Thus, significant gains are achieved in application development and maintenance costs.

Technology Architecture It is the layer in which the management of the logical technology portfolio for IT support and other applications. It is provided for all business applications that serve organizational capabilities.

Third party products are also included in the model as an attribute, the relations with the producers and the life cycles of the products are followed and the risks arising from these products could be prevented.

15.9.2 How We Done It?

Enterprise architecture organization should be carried out by providing senior management support with an approach focused on bringing together business and IT teams. In this context, it is necessary to establish an organization that will run the EA approach in the organization, determine the policies and implement them.

So, in our organization, the *Central EA Teams* have been established on both the IT and business side, identifying or presenting architectural services to meet the needs of all stakeholders in our organization. Architectural roles are distributed in the project teams. Responsible architects in the business, data, application and technology layers perform the specified tasks.

It is started to use *Service Oriented Architecture* to ensure working of different services together in harmony in the system. Since, the requirements for software functions are constantly changing and expanding, the phases are handled in a continuous cycle. *Kanban Agile Methodology* is assimilated at the software development lifecycle. Inception studies are executed at which projects followed on Kanban Board are divided into stories. Stories are planned according to the order of importance and flow of the process. The estimation work is carried out for each story and in this way scope of the project becomes visible. Also, codes for test automation have been executed. Thereby, while the software development is executed at the same time, product test is completed.

Analysis and software development user acceptances are carried out with in 2 week iterations. The iteration studies were presented at the showcases. Since iterations were executed with *Agile Teams* and in this way analysis, software development is completed in a shorter time with the alignment of IT and business. Also, all the processes were renewed by the *Process & Quality Management Team*. Traceability of complex processes is ensured with process automation on monitoring tools. While the processes were running, they could be monitored so that bottleneck analysis and process improvements could easily be executed.

A *User Experience Team* is constituted. For designing user friendly screens, usability analysis is one of the most important steps. In this phase, interaction and basic designs are prepared according to the results of the research by the user experience team. Afterward, usability tests are performed on the sample designs prepared with the participation of the concerned business departments in UX Lab.

Although the most relevant area of EA is IT layers, in our fiction, strategy is the start point. Changing the way you do business in today's world is the biggest gain by being aware of our current capabilities and what we have. In this sense, it is very important to draw the capability map of the organization.

The modeling of business capabilities technique is used in order to protect our organization from risks by combining its resources, competencies, information, processes and environments in order to realize the strategies of our organization and to add value to its customers.

Business value and maturity criteria were determined for capability scoring method. By means of the heat maps obtained through this method, potential investment areas (such as high business value but low-maturity capabilities) emerge, and the investments that need to be made on behalf of strategic priority can be determined through the links established with the strategic targets.

Roadmap for how to use the resources for the business capability to be acquired or terminated after *the strategic goal-business capability gap analysis* can be created. Thus, the decision to make investment is expected to be developed and the portfolio is aligned with the strategy in this sense.

We found solutions to problems by strong sponsorship support. Regular architectural governance meetings, project development showcases and continuous communication help bridge the gap between the business stakeholders and the project management team in order to eliminate the problems in the progress of the investments. At the end of each project learned lessons sessions were carried out. Widespread meetings were organized since the learned lessons could be learned by everyone.

15.9.3 What We Exactly Provided with EA Governance?

Acting within the framework of enterprise architecture governance is one of the greatest guiding. Benefits of using EA framework can be listed as follows (Met, Kabukçu, & Özenç, 2018):

- Visualizing and facilitating the management of the business processes on which systems they operate,
- Displaying of architectural components of enterprise structure in a single model,
- Thinking the unthinkable, to disseminate the architectural thought within the corporation,
- Demonstrating the effects of the changes on architecture,
- Reviewing plans and designs, ensuring compliance with standards,
- Identifying services that can be reused,
- Providing documentation in international standards,
- Determining principles, standards and roadmap.

In addition, we have created many benefits from our outputs based on our EA model.

- Relevant consolidated strategic goals and initiatives can be managed in a flexible manner with ensuring sustainable growth,
- Capabilities expected to be developed in line with the strategic goals which are determined.
- Strategy maps can be displayed in which investments and developments within the scope of strategic targets can be monitored.
- Strategic target-performance measurement can be made by monitoring the strategic development.
- Instantaneous reporting of application, data and technology architectural processes involved in the development of capabilities will be ensured.
- Following trends and giving directions to the future, investment decisions and portfolio management to be carried out on the basis of development of capabilities in line with strategic priorities.
- According to the needs of the business, throughout strategy priorities, project requests will be analyzed and more accurate resource planning will be provided.
- Operational IT cost will be associated with business values within risk management and business continuity planning.

15.10 Conclusion

Strategic mistakes cannot be corrected via tactical maneuvers.

There are three important considerations to be taken to achieve success. The first is that the relationship network between the architectural structures should be kept up-to-date. Otherwise, the system produces a decision with out-of-date data, which is the biggest risk posed by the system. For this reason, an orchestral system must be invested in order to ensure timeliness. So, architecture meta-model which is detailed from the highest level of vision to the lowest level of infrastructure level has to be created and to be ensured that all systems are followed as a whole.

Another important issue is the use of the created system in decision making processes. If this is not done, the generated system will only remain as an expensive reporting system.

The last important point is the need for time to internalize and implement the system. Especially after the establishment of this system, the previously hold wrong decisions that could not be seen before the system will began to be seen. In the meantime, those who find the system complex, as well as those who want to continue with the old habits should be predicted (Met, 2019).

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Chapter 16
Recent Developments of Artificial Intelligence in Business Logistics: A Maritime Industry Case

Gökçe Çiçek Ceyhun

> *"Artificial intelligence will reach human levels by around 2029. Follow that out further to, say, 2045, we will have multiplied the intelligence, the human biological machine intelligence of our civilization a billion-fold."*
>
> Ray Kurzweil

Abstract Fast-growing technological features of today drive all companies in all sectors to mechanization with automation by Artificial Intelligence (AI). As the maritime and logistics sector moves toward fully digital, AI becomes significant competition element for leading shipping companies in business logistics and maritime nations. Although the use of artificial intelligence requires great investment in the short term, it brings profitability by reducing the costs in the long term. Moreover the environmental regulations of IMO (International Maritime Organization) will hit the maritime industry in 2020 by forcing maritime companies to reduce sulfur content in fuel at 0.5%. From this aspect, using AI will also contribute to reduce ship related carbon emissions by implementing environmentally friendly applications. On the other hand, profitability of seaports will scale up by using emerging technologies that helps accurate forecasts by using scientific innovations related with empty and full container records and their allocations. Moreover, using AI will contribute to the prevention of ship related accidents by anticipating future cases with using pinpoint calculations. Lastly, the basic requirement of implementing sustainable development which is necessary to compete is to follow and implement technological innovations as AI. That's why this paper researches recent developments and current practices of maritime companies related with AI and shed lights on future studies in terms of shipping companies, maritime workers, governmental authorities and any other rule makers and practitioners.

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16.1 Introduction

As the world today is experiencing the third AI boom, the practical use of machine learning helps us to automatically identify and learn the patterns and rules from large amounts of data based on specific criteria. This technology will enable us to set more appropriate rules based on learning from data and make more accurate judgements once evaluation criteria are given. Following this, deep learning has emerged, in which AI learns by itself and accumulates the knowledge of patterns and rules with no specific criteria given. Besides, there are three major types of functions that AI plays in actual services. These are identification, prediction and execution (Otani, Toube, Kimura, & Furutani, 2018).

While the maritime and logistics business continue to be fully digitalized, AI has become an important competitive element for maritime companies and maritime countries in terms of business logistics. It is estimated that machine learning technologies together with unmanned applications may replace people within the next decade in maritime and business logistics sectors as in all other areas. It has already been implemented as human-free ports with machine learning algorithms and automation in the maritime supply chain networks.

The information gathered from AI technology gives competitive advantage ability to shipping companies by providing information related with weather forecast, maritime traffic, port traffic and any other know-how. Moreover, machine learning technologies has potential to allow shipping companies improving cost effectiveness by reducing fuel consumptions. The future vision of AI intends reducing accidents and incidents by presenting pinpoint data during entire shipping operations process.

In addition to these rising the number of ships used in international trade brings significantly pollution with it. Therefore IMO has approved the environmental regulation, which reduced the sulfur content in ship fuels to 0.5%. In order to adapt IMO's this new sulfur limitation rule, shipping companies will have to apply environmentally friendly solutions by using new technologies. When considered from this point of view, using AI will lead new implementations which help to minimize ship related carbon emissions.

For all these reasons, being aware of recent developments in AI applications is vitally substantial for maritime sector employees, shipping companies, governmental authorities and any other rule makers. Hence, the AI literature review, current executions and future vision of AI in world maritime industry have been conducted within the scope of this study.

16.2 Artificial Intelligence in Maritime Industry

Artificial intelligence is related with the ability of computers to fulfill the human thinking activities. People can program computers for having magnificent skills about searching, sorting and arithmetic. Most of these problems were considered as AI problems. However, there are many things that computers don't have enough capability as being creative, thinking what to do next and speaking our own language. These are the specialization of AI: try to find out what sort of algorithms are required to have these specifications (Millington & Funge, 2009, p. 4). At present, the ecological pattern of AI has been established gradually. In the following years, the specialized intelligent application will be the main potential area for the future development of AI. No matter if it is a specialized or generalized application, the enterprise layout of AI will focus on three basic levels of data and computing layer (base), algorithm layer (technology) and application layer (Liang et al., 2018).

Developments in autonomy and machine learning are rapidly enabling AI systems to decide and act without direct human control. Greater autonomy must come with greater responsibility, even when these notions are necessarily different when applied to machines than people. Ensuring that systems are designed responsibility contributes to our trust of behavior, and requires both accountability, i.e. being able to explain and justify decisions, and transparency, i.e. understanding the ways systems make decision and how the data is being used, collected and governed (Dignum, 2018).

Due to the fact that AI is a new field of study, the basics of this research area began thousands of years ago. AI which is one of the newest sciences was started to be studied seriously right after World War and the name was invented in 1956. The term of AI was firstly used in a conference at Dartmouth College, by John McCarthy. In order to study AI, it is required to have information on many subjects as biology, philosophy, psychology and linguistics. Moreover, AI needs to be used of new ways of intelligent behavior for solving complicated matters AI methods are applied in a wide range of sectors especially used in situations that traditional solutions would be too slow (Coppin, 2004; Russell & Norvig, 2003). Besides, AI continues to develop well since 1956 and it has reached a relatively sophisticated state in terms of both hardware and software, where the potential of industrial application is stimulated. Since 2013, with the rapid development of its related technology such as deep learning and knowledge mapping, the trend of AI technology industrialization has embarked on a fast track. Many giant companies have made remarkable achievements in terms of applications related with IT (Liang et al., 2018).

Philosophers, for over 2000 years, have been trying to answer to questions related with the universe as how a human mind works and non-humans have minds or not. However, the aim of AI is making machines do the works that requires human intelligence. For this reason, the main question is that the machines can think or not. Furthermore, the answer of this question is not simply yes or no (Negnevitsky, 2002, p. 2).

AI has always been related with enhancing the computer capabilities rather than acknowledging of its limits. Hence this is the main challenge which AI researchers face with (Luger, 2009, p. 2). Owing to the fact that presently AI is dealing with proving mathematical problems, playing chess, writing poems or diagnosing a disease, it is a really an universal field of study (Russell & Norvig, 2003, p. 1).

On account of the fact that AI is a world-wide study field, it is inevitable to be used of AI in a worldwide business industry as maritime. Therefore, it is vital for the maritime industry to examine the developments related with AI applications in terms of maritime sector employees and for future vision of companies. In order to understand the significance of AI in maritime industry, it is required to be acquainted with the advantages of using AI. Some of these benefits can be listed as follows (www.primaryfreight.com):

- Next level prohibitory overhaul: one of the most expensive matters that maritime industry is facing now is mechanical problems which include repair costs and loosing time. Developed machine learning algorithms are able to process data collected by sensors quickly and have the ability to learn statistical indicators that most accurately predicted, when a vehicle will need to be repaired. In actual fact, these innovations may be defined as "crystal sphere" for maritime sector. When the maritime companies can predict the future problems, they can proactively overcome the matters by minimizing downtown and keeping partners satisfied.
- Advanced distortion management: AI and related technologies are suitable for wider operations for disruption management. Some machine learning technologies began to rely on algorithms by selecting the convenient port when the target port was blocked. Similarly IBM and Air Company (IBM's subsidiary) have invented a project called "Deep Thunder". It's a kind of machine learning model that is envisaged for helping firms (in maritime and other industries) to get deeper information weather forecasts. This technology produce more accurate weather forecasts together with influences of hurricanes, storms and typhoons which is extremely important for shipping industry.
- Getting ready for the future: The widespread use of AI in the maritime transport and logistics sector still seems to be difficult. However, this does not mean that companies must sit back when they have been passed by their forward rivals.

Apart from above mentioned benefits, using AI in maritime sector provides competitive advantage in terms of fuel efficiency and reducing shipping based CO_2 emissions. While managing vessels in the shipping industry, CO_2 emissions and fuel costs can be considered as the major challenges. More than 2.6 billion USD is being spent for fuel by a big shipping company. It's required to define accurate estimates regarding with waves and winds effects on the vessel's speed for reducing consumption of CO_2 emissions and fuel. While present technologies related with these estimations depend on experiments or simulations of physics, they do not include complex wind interactions, currents of sea which effect the ship's rotation at actual sea (Anan, Higuchi, & Hamada, 2017). That means AI related developed technologies have potential to increase profitability by reducing CO_2 emissions and fuel consumption in maritime industry.

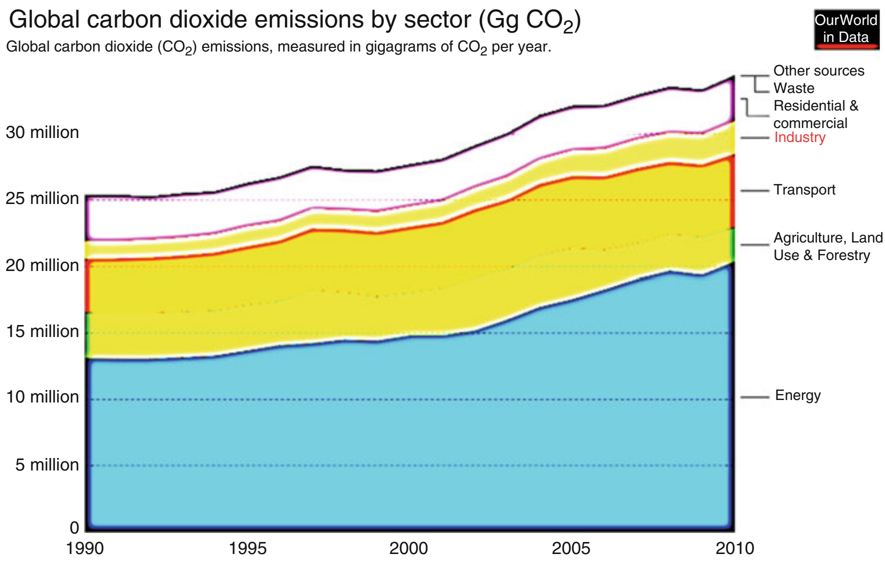


Fig. 16.1 Global carbon dioxide emissions by sector. Source: www.ourworldindata.org

On the other hand, AI in shipping industry is not only related with reducing costs, but also dealing with protection of environment by reducing ship related global carbon dioxide emissions. According to Ritchie and Roser's (2018) research, transportation activities that include road and rail transportation, domestic aviation and navigation together with other transportation cause increase in global carbon dioxide emissions of the world (Fig. 16.1).

Moreover, According to Fig. 16.2, total carbon dioxide emissions in 2015 was 36.18 Gt and Maritime based emission was 1.12 Gt. Hence ship based carbon dioxide emissions constitutes a substantial part of world total emissions. That's why International Maritime Organization (IMO) has executed new regulations for maritime industry in order to reduce ship based contamination. IMO 2020 is one of the most prominent regulations that influence the shipping industry by forcing maritime companies to keep sulfur content in fuel oil of ship at 0.5% level.

Related with IMO's above mentioned regulation, AI will also help the shipping companies for implementing this environmental policies by using machine learning technologies. Moreover AI will also provide using more environmentally-kind ships together with finding new sources of fuel oil which has lover sulfur content and minimizing navigation distances for reducing carbon footprint ın addition to these AI will help maritime companies to make plans for future surges regarding with oil prices. The shipping companies can start to use more developed GPS related AI solutions for finding the most convenient shipping routes in terms of oil consumption (www.smartdatacollective.com).

On the other hand, classification societies and maritime associations are also dealing with AI and forcing shipping related companies to use machine related

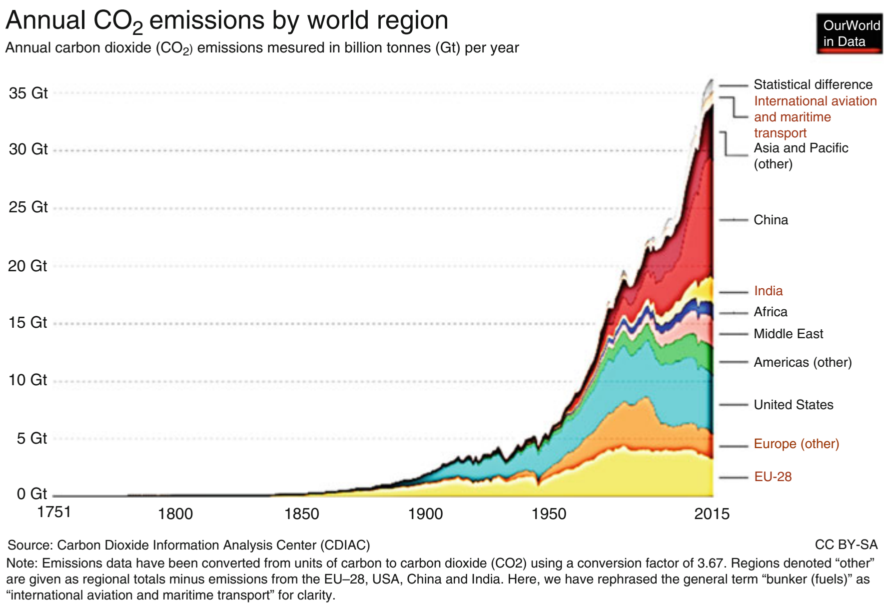


Fig. 16.2 Annual CO_2 emissions by World Region. Source: www.ourworldindata.org

technologies in maritime industry. One of the speech of Lloyd’s Register’s innovation strategy and research director Luis Benito has stated that AI will bring many advantages to shipping companies for protecting safety of people, decreasing accidents and increasing efficiency by reducing fuel consumption. High level autonomy will run a challenge because of complex AI systems such as analyses of situation, situational awareness and decision making programs. Finally all of these process bring cyber security problems with them and the system should be designed to protect against cyber threats (emag.nauticexpo.com).

As Lloyd’s Register, world’s largest international shipping association BIMCO has also recommends maritime related companies and other authorities to use AI. When attended to the 42nd session of the IMO’s Committee on Facilitation Committee, BIMCO has forced IMO to harmonize shipping data ID for maritime digitalization. It’s not easy to constitute international standards in shipping industry because of different IDs of several international standards. The main purpose of the mentioned data element IDs are finding practical applications for machine-to-machine solutions and to facilitate information exchange between services (http://mfame.guru/bimco-urges-imo-to-harmonise-digital-data-reporting/

Apart from all of these, as an international transportation field, maritime sector includes number of risks because of the vessels which are exposed to different dangers while travelling across international waters. It’s a well-known fact that more technologically equipped vessels are prone to eliminate human related risk factors by using modern technics. That’s why, AI based applications can be used to define the risks properly and get necessary precautions to avoid dangers and some accidents by using more sophisticated machine learning technologies.

16.3 Prominent Artificial Intelligence Applications in the World's Maritime Industry

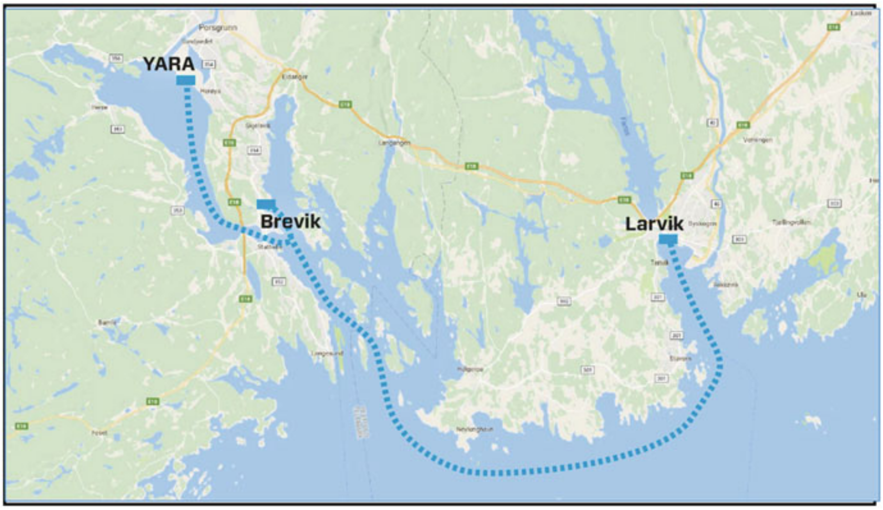
As all the industries in the world is being influenced from the rapid changes in technological advancements, maritime industry has its share from these machine learning evolution process in the recent years. Although the history of AI in the maritime field is not very old, there is a lot of practice in the world maritime sector. In spite of the fact that it is a complicated process to reach all the developments related with AI applications in the world's maritime industry, only the remarkable ones of all these implementations are included in this research.

AI will reshape the structure of shipping industry by using sophisticated machine learning technologies in the next couple of years. As a digital transformation key factor AI will provide actual decision systems for routing plans by providing vessel speed and weather information. Moreover AI will be a crucial challenge for maritime companies' future visions and strategies by integrating technological applications. Also, optimization of supply chain related with ships, terminals, transportation and warehousing together with optimization of container terminal operations will procure competitive advantage in overall the maritime operations (emag.nauticexpo.com).

One of the prominent maritime related AI practices comes from Norway. The container vessel named Yara Birkeland which is operated with autonomous and fully electric with zero emissions will be tested in terms of autonomous capability in 2019. It is expected to be delivered to owner and to start autonomous operations in 2022 (www.aitech.law). The operations of discharging and loading will be carried out by electronic cranes and devices. Due to the fact that the vessel doesn't have ballast tanks, the battery pack will be used as permanent ballast. Moreover, berthing and unberthing operations will be implemented with unmanned technologies by the virtue of having equipment for automatic mooring system. The target of the vessel is to sail in southern Norway for 12 miles between 3 ports which of the vessel traffic is observed by VTS System of Norwegian Coastal Administration. The mentioned operational area has been shown in Map 16.1 (www.km.kongsberg.com).

On the other hand, United Kingdom is also playing crucial role in AI for maritime industry by developing autonomous shipping. UK Department for Transport has organized a meeting at London with various attendees from different fields of maritime industry and UK government has received the opinions of different participants of shipping related with how UK can give support of using AI in shipping industry (www.aitech.law).

One outstanding example of AI in maritime industry is Wärtsilä's Smart Marine Ecosystem which presents a kind of ecosystem thinking strategy for implementing



Map 16.1 The operational area of Yara Birkeland. Source: https://vaaju.com/norway/yara-birkeland-is-to-be-built-in-norway/

pioneer changes to the shipping sector. The main scope of the Smart Marine is to provide the shipping firm to make connection with an intelligent ship by using two-smart-technology-equipped ports. The fundamental advantage of the system is rising efficiency in ship operations by using minimum resources that comprise of crew and natural sources as fuel. Another benefit of this application is protecting ecosystem by imposing carbon-free practices. The final profit of Smart Marine is sophisticated safety of operations which could be defined as vitally essential in terms of maritime industry (www.wartsilareports.com).

One of the remarkable examples of AI application in maritime industry belongs to the company of A.P. Moller-Maersk that uses World's First AI-Powered Situational Awareness System. The company has entered to agreement with Sea Machines Robotics for using AI to develop tracking abilities, object identification and at-sea situational awareness. The enhanced sensors receive constant flow of information from a ship's environmental surroundings and define estimated problems by providing efficient and safer marine operations in this system. The fundamental benefit of this process is to implement autonomous collision avoidance system AN-and to increase reliability, efficiency and safety at sea (maritimequote.nl).

In other respects, CMA CGM Group has cooperated with a company that is San Franciso-based Shone for using AI applications on container ships. Shone gets onboard data collection from ships and analyze information in San Francisco. After completion of this process, this innovation will provide facilitation of crew's works related with piloting, maritime safety and decision support. Shone is also dealing with anti-collision and security alert systems by getting and processing factual information from ships. CMA CGM Group and Shone's collaboration aims to serve as a worldwide model of AI application in the shipping industry (www.cmacgm-group.com).

A prominent practice of maritime AI application is being constituted by a Hitachi Europe Ltd., and Stena Line's partnership which serves for decreasing fuel costs and preventing environmental pollution. Together with this participation Stena Line aims to be a leader company on sustainable shipping of the world's maritime industry in 2021. By using machine learning technologies Hitachi will define the reasons of high fuel consumptions and will find solutions for efficient operations. Moreover, Hitachi will help fleet operations not only at ships, but also in shore by providing new talents, safer journeys and more developed operational efficiencies together with enhancing ship performance (www.hitachi.eu).

In addition to all these Orient Overseas Container Line Ltd. (OOCL) has cooperated with Microsoft Research Asia for the region of Asia Pacific in order to upgrade and installment of AI based applications. Microsoft Research Asia will assist in training 200 and more AI developers who are expert on machine learning technologies for OOCL during 1 year. This partnership may ensure approximately ten million USD cost saving by this network efficiencies in 1 year. According to OOCL, AI is the key digital element for making real business effect for expediting customer value. OOCL has already employing over 1000 AI developers in Hong Kong, San Jose, Shanghai, Zhuhai and Manila (www.oocl.com).

16.4 Conclusion

The world is changing every day and every new fluctuation especially technological variations influence people, life styles, business life, working conditions and industrial life. Due to the necessities of the time, most of industry is turning to be digitalized and thus maritime industry is also getting its share from this revolution by AI applications. Wind of change has already been started and nobody wants to stay out of the technological games coming with AI which is a prominent competitive element for maritime sector and all shareholders of shipping industry. As the number of human free ports and technological applications increase with machine learning algorithms, most ships will have to use AI, by reason of the fact that they will have to keep up with new systems. This machine learning implementations are being adopted not only by shipping companies, but also by industrial and governmental authorities together with other rule makers. Some of the applications that have been launched by featured serious authorities as IMO, BIMCO and Lloyd's Register have already shown that AI applications in the future will probably become mandatory for many companies.

When the global maritime sector is facing series of changes in our time, AI applications may give response to most of the problems as fuel consumption, security and safety risks, together with collisions and other dangers, human related errors, cost effectiveness of the maritime operations, environmental pollution, adaptation of new regulations, and etc. Will all these problems be solved by using AI? It's a future based question that nobody can answer without experiencing the cases. However, AI has potential to change all the shipping environment radically by forcing great numbers of maritime companies and other shareholder of shipping industry to use machine learning technologies in order to compete with each other for surviving in the near future.

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Web Resources

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Chapter 17
Use of Artificial Intelligence as Business Strategy in Recruitment Process and Social Perspective

Pelin Vardarlier and Cem Zafer

Abstract The artificial intelligence (AI), which has started to show itself in every field of the changing business world, has now begun to manage the recruitment processes in the human resources departments of enterprises. With the adoption of new technologies in the digital age, business structures have to adapt to new designs and increase the performance of business processes. Providing the right human resources during the recruitment process is one of the most important functions of human resources management. In particular, it is important for an enterprise to find, attract and manage talented employees. A talented human resources department is the most strategic point that directly leads an enterprise to profitability. At this point, candidate evaluation stages are very important for a successful recruitment process. In this regard, it is important to have accurate monitoring and evaluation tools associated with the performance and potential of the candidates in terms of the organization of enterprises and management of human resources. In consideration of the foregoing facts, the aim of this study is to reveal the benefits and risks of AI-based use on human and community in recruitment processes in human resources department. The applications of artificial intelligence are explained with examples.

17.1 Introduction

Human resources are one of the most important departments that add value to an enterprise and ensure the continuity of corporate culture. Especially in recruitment processes, the task of human resources is critical. Before the digital world, businesses were experiencing a lot of intensity due to applications during the recruitment

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process. Due to the stages such as examination of each application individually, interview with selected candidates, it was taking a long time to fill a position. A new era has been opened in recruitment processes with the increasing artificial intelligence in the business world. This process, which began to be referred to as HR 3.0, an important stage has been left behind especially in the stage of filtering candidates. Thanks to simple filtering algorithms, the candidates are evaluated immediately according to many criteria such as the graduated school, business and sector experience and overseas experience. In this way, the human resources department can directly eliminate people who are not suitable for their positions. This allows both businesses to fill their vacancy faster and save time and effort.

When the issue is discussed in terms of businesses, it is not possible to mention that each business provides data in the same structure. As a matter of fact, enterprises can be subject to some basic distinctions such as size and smallness. In this context, to discuss separately the business large-qualified will be healthier. Thus, because there are a lot of data in organized structures that are created as complex in large enterprises, their analysis, evaluation and approval phase represent a long and difficult process. At this point, information or technology comes into play. Data stores, supported by technology and equipped with data mining tools, offer an alternative such as providing the necessary data to human resources as soon as possible with the help of Artificial Intelligence and helping to make decisions that will be taken over this data (Jain, 2017: 35). Artificial Intelligence (AI) has been used by many businesses for a long time and continues to develop continuously. Technological developments offer new opportunities to deal with the problems people face in their professional and personal lives. In the case of businesses, it seems that artificial intelligence changes the way people recruit and search. In this context, the following section explains how human resources processes are realized through artificial intelligence.

17.2 Artificial Intelligence Concept

When the literature on the definition of the concept of intelligence is examined, it is seen that this word is defined as a structure that covers the whole process such as thinking, reasoning, understanding the realities of concrete objects, reaching the results by judging through certain types of thought or information (Topçuoğlu, 2001: 39). It is known that the concept is based on Latin culture as origin and is referred to as "intelligere" in Latin. It is noted that the concept of Latin "intelligere" consists of a binary structure. Although the first of these "inter" means "between", "ligere" is referred to as "selecting" or "reading". The concept of "intelligere" which is formed by the combination of this dual structure is defined as "comprehensively understanding" or "reaching consciousness" (Doğan, 2002: 19).

Based on the definitions made on intelligence, if it is needed to make a definition of the artificial intelligence; it is possible to define artificial intelligence as systems that perform functions related to intelligence on non-organic structures. However, when the definitions of artificial intelligence are examined in the literature, it is seen that there is no generally accepted definition. In the literature, it is possible to sample the definitions about Artificial Intelligence as follows:

In the definition of Artificial Intelligence made by Barr and Feigenbaum, Artificial Intelligence is considered as the intelligent structure of computer science. In other words, branch, which deals with the creation of systems that have the qualifications of learning, reasoning, problem solving and using certain language patterns of computers, is defined as artificial intelligence (Barr & Feigenbaum, 1981: 3).

The problems that the formulation cannot establish mathematically and which are impossible to resolve can be solved by computers through heuristic methods with artificial intelligence. Studies that equip computers with these features and enable the development of these features are known as artificial intelligence studies (Öztemel, 2012). The general purpose of artificial intelligence studies is to model the working logic of the human brain and to make groundbreaking developments in every phase of science through these models. In this context, when the studies on artificial intelligence are examined, it is seen that the main field of interest in this intelligence application is decision making (Nilsson, 2009). However, it is worth mentioning that Artificial Intelligence applications are not systems designed to make simple decisions at the basic level. Although all activities carried out in the field of Artificial Intelligence are intended to create complex decision-making mechanisms, it is useful to say that the beginning in this field consists of simple mechanisms. However, the main goal to be achieved in Artificial Intelligence applications is to be able to make a self-decision of the system and to develop structures that can implement these decisions (Kolbjørnsrud, Amico, & Thomas, 2016). In other words, the main point to be reached in artificial intelligence applications is to bring machines to a level that can decide by using intelligence like humans. Based on this goal, it is aimed that the machines can learn by experience, know the information which needs to be reached and what information is needed and make a decision as a result from these implications (Ingizio, 1991: 45).

The concept of Artificial Intelligence is a structure that mentioned first in the article "Intelligence in Calculating Machines" published by the English mathematician Allen Turing. However, in this article, it is seen that the expression of artificial intelligence is not explicitly used. In this article, Allen Turing, as a general admission, answered the existing prejudices that machines could not think like human beings under various headings. As a concept, it is seen that artificial intelligence is used in a conference in 1956. At this conference, opinions suggested by scientists that computer programs equipped with intelligence can be developed were again called "artificial intelligence" by these people. However, at the same conference and afterwards, this naming met with a clear rejection-based approach. However, this development, which is continued to be used and expressed as artificial intelligence has used the same way up to the present (Hant, 1986: 2).

17.3 Basic Characteristics of Artificial Intelligence

Even though its history was based on previous periods, it is seen that the development studies on Artificial Intelligence has been increased to a higher level after 1960s. The basic point to be created in this structure is to develop computer systems that can decide, think and learn like a human being by taking the human brain as a model.

One of the main features of Artificial Intelligence applications developed for these purposes is the difference between classical applications. As a matter of fact, the exact rules do not apply in Artificial Intelligence applications as in classical applications. In other words, artificial intelligence applications have not emerged as a structure that leads users to the desired result after certain steps. Artificial Intelligence applications have a number of structures called heuristic methods that are not available in classical computer programs. Heuristic structures, as in classical computer programs, are not systems that lead to conclusions with absolute basic steps. On the contrary, in the context of the questions directed to him, the answers given, the interactions, it is known as the methods that determine the methods according to the specific goals and preferences and to determine the methods for achieving these goals. One of the greatest features of heuristic methods, that it aims to reach a decision in the transaction point absolutely. In this regard, heuristic methods are constantly known as methods that can be solved (Haton & Haton, 1991: 12).

The main application areas of Artificial Intelligence applications where heuristic structure is used are the processing of natural language, processing of images, proving theorems, recognition, game programming and robotics. The goal to be reached on the processing of natural language which is one of the most remarkable applications in this regard is to provide the perception of sentences presented to the computer system within any language structure and to be understandable by the computer. However, when it was also taken into consideration that the languages were variable during this process and that the words within the language could have different meanings, it is understood how difficult it is to perceive them by computers. For this reason, all the dimensions of the structures are transferred to Artificial Intelligence applications so that such structures can be perceived and understood (Maden, Demir, & Özcan, 2003).

The applications aiming to recognize image and use of artificial intelligence are applications which aim to recognize the environment of computer system where Artificial Intelligence is established. For this reason, in order to achieve the stated purpose, the images obtained by the cameras connected to the computer must be converted into a number of digital signs and these signs must be subjected to the operations previously recorded in the database (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013). This structure is especially used in production systems and in the factories; the order of the production lines is not disturbed by the image processing. However, image recognition activities are structures that enable usage in different areas. As an example of these uses, it is possible to give the mechanisms that enable people to log in and out with facial recognition systems. Another form of artificial intelligence in the field of production and supporting the image recognition systems is the applications called robotics. Robotics refers to the use of business automation in industry when considered in conjunction with artificial intelligence. In addition to the use of Artificial Intelligence, the concept of robotics also refers to a general structure that is used to express all areas of robotics technology (Erden, 2003: 5).

17.4 Recruitment Process

The use of electronic structure or digital systems in the field of human resources is an issue that maximizes the processes of functions and the quality of service at the point of reaching the human resource (Bulmash, 2008: 73). This point refers to a structure that is mentioned in the literature. As a matter of fact, when the literature is examined, the communication and interaction channels are “nervous system” in terms of organizations, although there is mentioned, in order to work in a healthy way, to be able to create the desired effect and to be useful at the point of obtaining and processing the necessary information again in the field of human resources, they were considered to be useful (Leblebici, 1996: 2). Walker who works on the use of digital structures in human resources, to obtain the information necessary for the use of information technologies in this field, to store them, to evaluate them as a result of the necessary analyzes and to pass the approval phase, there is a systematic procedure (Walker, 1982).

All of the actions that the company provides the appropriate labor force that it needs, constitute the selection and placement process. The aim of this process is to ensure the control of the suitability of the individual’s abilities with the workforce needed by the company. For this purpose, the recruitment process includes activities aimed at the research, selection and recruitment of people with the appropriate qualifications required by the company (Acar, 2013: 87). At the same time, it is not only relevant to the recruitment and retention of the required number and qualifications of the employees, but also to the fact that these people are in line with the organizational culture and strategies (Canman, 2000: 78). However, business and person compliance are also used to indicate the compatibility of people with companies (Mathis & Jackson, 2008: 227). In this respect, organizational policies, the effects of government, recruitment costs, the status of the labor market, the competition situation with other firms, economic trends, labor unions and developing technology are the factors that affect the process of selection and supply n of human resources of enterprises (DeCenzo & Robbins, 2007: 150–151; French, 2007: 230; Koçak & Yüksel, 2011).

Businesses sometimes benefit from internal and external resources in the procurement of candidates for vacancies. However, it is appropriate to decide which resources are appropriate for a company, taking into account the conditions of the enterprise and its position. However, in the candidate selection, there are useful and objectionable aspects of referencing both internal resources and external resources.

Whether it is internal or external source, which resources to apply; the point to be considered here is the determination of the candidates in the candidate selection process and the method followed (Uçkun, Latif, & Öztürk, 2013: 39). In this respect, the negotiation which is held for a specific target among multiple individuals during the selection stage is called the interview. In other words, in order for a candidate evaluation and screening process in human resources processes to be called interviewing, firstly, this interview should be directed towards a specific purpose (Altun & Kovancı, 2004: 55).

In the evaluation stage of the interview, based on the analytical data, it should be carried out to determine whether the candidate has the required competencies for the job and whether he/she has the required skills and experience (Heuvel & Bondarouk, 2017; Nishida, Chen, & Mohri, 2007). In this evaluation, the candidate's knowledge of the various behavioral responses and the responses and competencies required by the position and position of the candidate are measured. With his behaviors and the indicators on which these behaviors are based and their physical or emotional responses; evaluated by the interviewer, the opinion about the suitability of the candidate to the position is formed (Uzun, 2008: 54). In order for the opinion of the interview process to occur, information about the candidate should be determined in advance and how much of this information will be obtained from different sources (such as references, tests and inventories, certificates and diplomas). However, for the successful conclusion of the interview; regardless of the position of the interviewer, he/she should be aware of the fact that the interviewer is the manager. In addition, it is necessary to measure the suitability of the person to the position by directing the right questions in line with the planned road map (Terazi, 2011: 147). Accordingly, a questionnaire for the interview should be prepared beforehand and the types of questions to be asked should be determined. Any question to ask in interviews should have a purpose. At the same time, the questions that can be asked can vary depending on what information is requested (Çavdar & Çavdar, 2010: 89). In order to determine the questions, the expected answers should be categorized first. Generally expected here, it is in the form of answers belonging to social life and standard of living, personal information, education, professional experience/knowledge, personality traits, competencies, motivation, expectations and conditions. Questions to be asked in order to obtain answers to these types of questions may change. However, the main objective of the interview process is to collect data for the next steps and final decision by evaluating the candidates' adaptation to the business in the interview. With the answers received in the interview, a detailed assessment of the candidate's ideas, attitudes and abilities is made. As well as the answers of the candidates in the interview, in this process, factors such as the effects of the respondents in the interviewers and their external views give helpful information in this process. Candidates who are successful at this stage go to the next stages defined in the company.

It is the final stage of the human resources procurement and selection process to decide on who will be recruited during the recruitment process. If there is only one position to fill, the company can hire the candidate who has the highest score and thus and thus decision-making can be very easy. However, decision making is difficult when many people need to be employed for the same position (DeNisi & Griffin, 2008: 234). At this point, the criteria that have been set correctly and weighted correctly will allow much more accurate decisions to be made in the elections. Therefore, it is very important to determine the criteria to be used in the selection process (Aksakal & Dağdeviren, 2010; Özdemir, Nalbant, & Başlıgil, 2018).

Human resources management professionals or business managers have difficulties in making the right decision or selecting the most appropriate candidate or candidates, how to use the information obtained from candidates. Different methods have been developed to reduce these difficulties and, in other words, to make the right decision when combining information about candidates. A variety of tests and documentation are used for a more rigorous recruitment process. These methods include the use of statistical analyzes by quantifying test results, determining the minimum levels of qualifications required for jobs, eliminating the candidates under it, and matching the job application forms or candidate's qualifications with the job requirements (Fisher, Schoenfeldt, & Shaw, 2006: 298–301). In this respect, assessments are mostly carried out with a personal background and face-to-face interview technique. In the past, the best advice for candidates is to prepare a good CV and then submit an application and wait for the answer after investigating the relevant job postings that they see fit with their skills, but now more proactive approaches come to the fore. At this point, employers now take advantage of today's technology to manage the first evaluation of candidates and this brings job search rules to new areas. In this process, it is seen that the enterprises use artificial intelligence in recruitment. This approach enables the recruitment process to progress more quickly.

17.5 Artificial Intelligence and Recruitment Process

Artificial intelligence is one of the most important developments that can make a difference in today's business world. The use of artificial intelligence along with the digital conversion age has also caused the recruitment process to be shaped. In this respect, within the stage of data collection of potential candidates, analysis and evaluation of these data and making a decision as a result of evaluation, the use of artificial intelligence is a very useful support activity for recruitment.

Before the big companies were involved in the artificial intelligence process, they were managing recruitment as a more laborious process. To reach the candidate they need, newspaper ads or advertisements advertised from the company were used. With the proliferation and use of the Internet, companies have started to present on-line advertisements for recruitment. Thus, more candidates have been reached. But the problems of the recruitment process did not end in this way. Because many candidates who are not related to job criteria are applying to try out their chances. When there are too many applications, enterprises have to employ extra staff to eliminate the applications and this increases the workload of the recruitment process.

Artificial intelligence has greatly removed the burden of human resources in the recruitment process. Artificial intelligence is able to easily perform the candidate elimination process which was formerly made by the employees. Thus, businesses are taking fewer personnel to the human resources department to reduce spending. Nowadays, by means of artificial intelligence, enterprises can determine the candidate criteria through the program and reach the candidate they seek. Thus, every detail is determined about the candidate's school, talents, experience, place, even hobbies. In this way, the eliminations can be realized automatically and quickly. For example, hundreds or even thousands of applications are made for Apple, which is a very large company. Artificial intelligence limits the number of these candidates in just a few minutes and can reduce them to double-digit numbers. In other words, these recruitment processes where technology is used are described as "smart recruitment process". At this point, technologies such as artificial intelligence, cloud computing, data analytics and block-chain are one of the most important technologies that have created this effect. Artificial intelligence has enabled the production of autonomous tools, chat-bots and robots that decide on their own, both nurturing these technologies and feeding them (Bersin, 2018).

As a matter of fact, artificial intelligence has first taken steps in the recruitment process with filters. Thanks to simple filtering algorithms, the candidates are divided into graduated schools, business and sector experience, foreign experience according to the criteria determined in a very short time. Perhaps the most advanced level of filtering systems is the Talent Rediscovery algorithms, which are formed by the Restless Bandit company. Reckless Bandit is known as a company that aims to offer the most suitable candidate for enterprises by using advanced filtering algorithms. With the help of filtering algorithms, a company's application monitoring system is constantly following up to find its own personal backgrounds that match the current positions of businesses. Then it sends an e-mail to the business owner to contact the potential candidate. In addition, it keeps the application review system up to date by taking into account the information in the social media accounts of the candidates. Finally, it constantly encourages applicants by automatically sending e-mails to candidates and even adding ads to their Facebook pages. Although the algorithms of the Restless Bandit company are advanced, filtering algorithms are not considered to be too advanced for the technology age we are in. The main use of artificial intelligence is at the stage of the interview. Chat-bots created by artificial intelligence algorithms are now used in interviews. To define a chat-bot, it is a piece of software that communicates with the person through a specific scenario, asking questions, and continuing to talk according to the answers it received. In other words, it is defined as an undeveloped virtual assistant (Cerebro, 2018).

According to a survey conducted by Service Now company between 350 senior HR managers, managers find artificial intelligence technologies very useful because they can access the information they want at any time. In this way, they think that time is saved by bypassing the bureaucratic process. Another result of the same study is that 92% of managers think that the services given to staff in the future will be almost entirely over artificial intelligence. Another conclusion is that communication with employees over chat-bots provides extreme comfort in some cases (Cerebro, 2018).

Recruiting Innovation, founded by Alison Daley, a former technology recruitment officer, aims to help human resource employees in selecting candidates for specific critical positions. Recruiting Innovation focuses on the development of human resources personnel, providing many resources for recruiting professionals to develop themselves in technical matters (https://recruitinginnovation.com/). However, an artificial intelligence initiative, Allys, besides the technical information of the candidates with artificial intelligence-assisted video interview with the face recognition technology, speech to text translation and voice tones analysis features, human resources authorities to provide convenience and the right candidate placement service provides. When looking at the process of Allys working on a video interview, the candidate who is uploaded to the system tries to understand the situation using face mapping technology on the interview video, translating his speech into text and analyzing it on the job. It also analyzes the candidate's tone of voice. With all of this, the candidate is subjected to a score system on self-confidence, energy, positive behavior, pronunciation, and provides an insight about the candidate to the human resources officer. So, if it is pretty good about candidate and technical skills but if it is not good enough in terms of communication, harmony and responsibility, which are defined as social skills, it can see this as an objective and improve the decision-making process with Allys (https://www.myally.ai/).

From this point of view, the use of artificial intelligence supports the consultative role of human resources employees and allows them to focus on more qualified results in the more humane aspects of recruitment. One of the chat-bots designed for job interviews that can be addressed to this point is Mya, the industry's leading artificial intelligence recruitment assistant. Mya Systems was founded in San Francisco in 2012 by Chairman Eyal Grayevsky and Chief Technology Officer James Maddox. Mya, the artificial intelligence robot, is asking realistic questions to assess the appropriateness of candidates to the position. These include questions such as: "Are the dates set for the internship suitable for you? What department are you studying right now, and how long do you have to graduate? Is there anything we can do for you to complete your application? When can you start work? Are there any questions you'd like to ask me about corporate culture or the details of the position?" Mya, an artificial intelligence, can automate the recruitment processes and select the most suitable candidate for the work between thousands of CVs (https://hiremya.com/). Therefore, it manages an effective process in finding candidates capable of objective questions that do not cause misunderstandings. Speaking artificial intelligence platform can reach and communicate with candidates in the process of automatically recruiting with natural language processing and machine learning techniques. Among the most important users, there is Adecco Group where L'Oréal also is the customer. At the same time, this chat robot is also used to recruit positions such as internship or beauty expertise in L'Oréal. With the introduction of the system for recruitment in L'Oréal, it has been observed that the satisfaction of the candidates in the application process has increased. The use of artificial intelligence has made possible for L'Oréal, who received more than one million applications per year, to evaluate more applications. It is possible to reach Mya, which is user-friendly, from mobile phones at any time and from anywhere. Mya first introduces himself as a chat robot. In the final stage, it brings together the appropriate candidates with recruitment specialists. When job-seekers have difficulty accessing the necessary information about their applications and do not know the processes, this technology provides a formal and human-oriented experience with regular reminders and information (Clichy, 2018). For example, while doing a survey on gender discrimination or psychological violence in the workplace, the HR officer cannot feel comfortable because of the answers he/she can take at the moment, the same survey can be done very easily via chat-bot. In addition to the mentioned systems, different chat-bots such as JobPal, MyAlly, Debra are available and are used by businesses.

As well as Chat-bots, another innovation brought by artificial intelligence is the video interview application. HireVue, a start-up based in Utah, is one of these companies. To find the most suitable candidate for the job, after taking the interview, HireVue records the gestures of the candidates during their interviews, their gestures, their changes in tones and their micro expressions with artificial intelligence algorithms. For example, it is able to determine whether the candidate lied about a certain matter during the interview based by growing and shrinking of people's pupil or from a movement that he/she made at the time. At the same time, it aims to get rid of the prejudices that may occur in interviews with such analyzes. Working together with HireVue in recruitment processes since 2016, Unilever has evaluated 250,000 applications with artificial intelligence technologies. Unilever, who received twice as many applications as previous recruitment due to digitalization, explained that he reduced the recruitment process from 4 months to 4 weeks and thus saved 50,000 h (Cerebro, 2018).

As a matter of fact, Artificial Intelligence applications used in recruitment are not technological structures applied only to individuals who apply to the business and who are subjected to evaluation by giving their personal information in this way. In addition, artificial intelligence has features such as access to the skills needed by the workplace and making interviews with these skills (McGovern et al., 2018). With Artificial Intelligence applications developed in this context, it is known that software can work and develop without any human intervention in recruitment processes or personnel elimination processes. However, with some Artificial Intelligence applications developed, the data added to these applications may provide suggestions on which personnel are deemed appropriate to the positions clearly stated in the workplace, and in doing so it does not differentiate due to the behavior of any personnel. This leads to a more equitable distribution of tasks and a merit-based recruitment process in the workplace (Malhotra, 2017: 539).

The next issue with hiring and artificial intelligence is how to use artificial intelligence to get a better recruitment as a recruitment specialist. The recruitment specialist will create the recruitment and interview processes and requirements necessary to enable artificial intelligence to learn and understand the content. The recruitment specialist is able to design the correct data pools and interfaces that artificial intelligence needs. In this respect, developments in artificial intelligence seem to have efficient assistants rather than hiring specialists. The job of the recruiters will be to direct the right questions to analyze the candidate during the interview with artificial intelligence and to decide which candidates should pass through the pre-interview stage. In the future, the current questions and responsibilities of recruitment experts in the process of candidate analysis for candidate selection in the pre-interview are to help artificial intelligence gain a decision-making structure that both analyses the candidate and analyzes the candidate. However, there is still a need for human intervention to make decisions based on the results of the machines (Gültekin, Biroğul, & Yücedağ, 2015). Recruitment specialists have greater advantages over artificial intelligence. Teaching skills are an advantage to artificial intelligence, because stakeholders' motivations and needs are better understood. However, it can capture non-verbal clues better. Visual thinking helps to adapt communication by following the reactions of the audiences. Creative thinking provides new ideas and approaches to solve problems and identify opportunities. Such capabilities make people different from artificial intelligence (Köroglu, 2017).

It would be better to go to trial and error in order to achieve success instead of the expectation that artificial intelligence will change everything in an instant. Artificial intelligence has taken rapid steps in cognitive science and there will come a time when machines can "think and decide" on the basis of changing forms of people. If the recruitment process is required to work with artificial intelligence, it will be necessary to focus on social skills, emotional intelligence and learning how to use artificial intelligence. Nowadays and in the near future, it is possible to say that machine learning and artificial intelligence will help to make preliminary predictions in the process of deciding whether recruiters and candidates are positive or not.

17.6 Potential Benefits and Risks Associated with the Use of AI in Recruitment

At the point of the use of Artificial Intelligence applications, which are becoming more and more widespread, in human resources activities, it is possible to see some positive and negative points emphasized in the literature.

In terms of the technological structure in human resources processes and the benefits provided at this point, priority is given to artificial intelligence applications to human capital, individuals to provide development in terms of career, and in this way to increase the size of satisfaction they reached in the work they are doing. For example; with an artificial intelligence application called Engazfy, individuals can carry out their professional development in a more healthy way. The program enables individuals to take more robust and more consistent steps by directing them towards their career goals. In doing so, it monitors individuals in the process and gives feedback on the wrong situations (Göçoğlu & Kurt, 2018). Another example of such artificial intelligence applications is the application known as

Wade & Wendy. This application is also designed to provide individuals career development and to guide the individual in the sense of career, and to advance the business life more systematically (Malhotra, 2017: 540). These issues highlight the direction of facilitating the activities of the department of human resources, which also has responsibilities in point of the career of the personnel.

However, it is possible to see that artificial intelligence has very useful uses in job interviews. As a matter of fact, it is known that artificial intelligence programs have decided on the personnel by examining the video recordings made during the interviews and the responses given to the candidates to the questions given to him in these video recordings. At this point, a data set is formed in the video record about the behaviors of the individual based on gestures and mimics. As a result of the analysis performed after the creation of this data set, to determine whether the person is eligible for the job to be taken, whether he/she will be successful in this business, and what kind of ratio will be between his/her past success and future success, it can make suggestions in the process of decision making at the point of recruitment (Malhotra, 2017: 539). Another advantage of artificial intelligence is that recruitment processes become more objective. Stress and excitement have disappeared. Although artificial intelligence reduces the number of employees, its effects are generally observed positively. While saving both time and work load, at the same time the desired staff can be found faster. In the application process, it is observed that it has also eliminated the prejudice. At the same time, artificial intelligence can use the natural language processing capabilities to screen critical and non-structured resumes to identify critical information and draw a more accurate picture of an ideal job for a particular candidate (McGovern et al., 2018).

Although there are so many useful aspects, it is also known that there are negative aspects of using technology or artificial intelligence in recruitment processes and human resources. Although one of the biggest positive aspects of the use of artificial intelligence in the field of human resources is the aspect of facilitating things, one of the biggest problems that may arise in this regard is the adaptation problem of getting used to Artificial Intelligence tools or using these tools. This adaptation problem causes a resistance at the point of change especially in human resources employees. This resistance, which may also arise in the field of human resources, will constitute the first step of a radical problem in terms of reaching the desired targets. Due to these and similar problems, the effects of Artificial Intelligence applications on management processes in enterprises need to be minimized (Göçoğlu & Kurt, 2018).

Another point that can be taken into consideration in this matter is that relying too much on the data can lead to wrong progress. If the recruitment is done according to the same criteria, then the algorithm decides in this direction and can make a different inference. For example, Amazon has cancelled its artificial intelligence program for use in recruitment processes on the grounds that it discriminates. The reason for this was that this search engine, based on artificial intelligence, ignored female candidates because of the dominance of men across the technology industry and in the Amazon's 10-year history of recruiting. In this respect, Amazon has stopped the use of artificial intelligence system in recruitment, which concludes that men are more preferred (Provost, 2018).

Consequently; artificial intelligence can never replace human resources, even if it continues to make significant progress. No matter how advanced technology is, hiring will basically remain a human activity. When job seekers and employers interact with human resources specialists, they feel the sense of trust, loyalty and teamwork; this cannot be copied by machines. The role of Artificial Intelligence is to provide more time for human resources. Thus, by focusing more on human relations, it makes them perfect at what they do.

17.7 The Future of Recruitment in Artificial Intelligence

Although the use of artificial intelligence applications in recruitment processes and its results are evaluated, it is certain that the involvement of artificial intelligence in the channels in which people are actively involved, such as recruitment processes, will have some social reactions or effects.

At the beginning of these effects, it is possible to address that the Artificial Intelligence applications which think like humans and decide like humans and replace humans in production activities and as a result, the emergence of a mass unemployment problem in the social sense. It can be said that this unemployment problem occurs under a two-dimensional structure. The first of these is the point that is related to our subject and which is effective in recruitment processes at which point Artificial Intelligence may cause misconceptions by taking decision of individuals over the responses of individuals by ignoring stress, psychological situation, pressure and similar factors. As a matter of fact, although these mechanisms have structures such as self-learning, it will not be a misinterpretation to say that there are some human-minded practices such as sensing the psychological state of the individual, providing the individual to relax, providing him with guidance to express himself correctly. In addition, people's intellectual response from the situation of being in contact with a mechanism is another issue that will affect the outcome. Also with the similarity of software to human intelligence, not being on the same level with this intelligence, it can be said that the system developed can be manipulated by people (Conrad, 2019).

Another dimension of unemployment is the fact that artificial intelligence practices, which are defined as robotic applications and which are included in production activities, cause individuals to stay out of production activities. At this point, even though there are people entering a race with the machine, employers will be able to push people out of the production sector by choosing machines that they do not pay for working hours, which they have determined the working times by themselves and can make production more systematic. This will result in the emergence of a group of people who are in a difficult situation in terms of unemployment and therefore economic conditions in the society, even if the production activities are increasing within themselves. This difficulty can be considered as a development that can be indignant in society (Cleveland, Byrne, & Cavanagh, 2015).

Another point that can be taken into consideration in this matter is that people ignore the development of these professions because of the use of artificial intelligence in production activities or in various professions. As a matter of fact, people will not be able to get training or develop themselves because they will not find employment opportunities in areas where intensive artificial intelligence is used. However, there will be stumps in certain professions where artificial intelligence is not used or is used less, and there will still be a fall in popularity shown by people as a result of adaptation of artificial intelligence to these areas. This will create the first step of the formation of a society that has lost its hope in the general sense of the future, has no great expectations in the economic sense and is hostile to the machines (Collings, Wood, & Szamosi, 2018).

Rapid progress in the field of artificial intelligence and robotics creates the impression that the need for human labor in many professions will be reduced. Reported reports suggest that employment of workers, factory workers, teachers, cashiers and even doctors will be reduced. However, when the issue is examined more extensively, it is seen that new business fields are opened instead of shrinking business volumes. In other words, professions are changing shape, adapting to technological changes or disappearing. As a matter of fact, new professions are replaced by the disappearing professions. According to a Gartner research, as of 2020, artificial intelligence will destroy 1.8 million jobs and create 2.3 million new job descriptions (Ghosh, 2017). Another striking finding in the report is that artificial intelligence will increase workers' abilities. Artificial intelligence and human partnership will drastically change the business profile. Artificial intelligence will help improve the skills of recruitment specialists. In the next 10 years, recruitment specialists will collaborate with artificial intelligence and machine learning solutions to conduct preliminary interviews, analyze and evaluate candidates. In fact, "intelligent systems" will work together to learn with people so that one day they can make decisions like recruitment specialist (Orhan, 2019). Artificial intelligence is moving at an incredible speed, and it does things once thought only humans could do. But there are still areas where algorithms need people. It is possible to say that it will replace the recruiters in the future and instead, to say that specialists will be a member of automated systems for advanced interview interviews. Artificial intelligence will empower people instead of weakening their role. Artificial intelligence will easily replace jobs with low added value in the business, so human resources specialists will focus on recruiting to create higher value (Boudreau & Ziskin, 2011; Yıldız & Yıldırım, 2018).

According to the study of Oxford University, by 2035, artificial intelligence would replace almost 47% of all jobs. This ratio is really a forecast to be taken into account. Firstly, people in their mid-40s are less concerned than they are likely to approach retirement. But young people have enough time to adapt and prepare themselves for this future. Only with the advancement of artificial intelligence, many jobs will not be eliminated. Instead, various aspects of a job will gradually replace it with artificial intelligence. However, it is early to say that smart machines will replace recruiters in Human Resource Management in the artificial intelligence world. However, it will not be wrong to say that many recruitment specialists take the pre-interview role by robots, digital assistants, or automated applications (Ghosh, 2017; Provost, 2018).

Artificial intelligence or robots to conduct the recruitment process sounds good, but without the human factor, it is impossible to do so. It will be an emotionally free interview and it will become difficult to express him/herself. For this reason, some issues will be more difficult to explain. Because artificial intelligence can't run a recruitment process from start to finish. It can only exist to facilitate the recruitment process. All technological developments or products used today or in the future host humans inside. The only reason they are produced is to make people's lives easier. Therefore, when artificial intelligence makes the recruitment process, since the evaluation will be made only with concrete data, it means that many people are disadvantaged. Because artificial intelligence can't be a talent hunter because it's free from human emotions. It will only evaluate a person with the data it has.

When looking at the future of human resources, especially the evaluation mistakes, the recruitment of wrong people and job descriptions are not created correctly, so many problems can be faced. Today, we are still asking the questions we asked 10 years ago, and this is a very important obstacle to the development of human resources. First, structural change is needed, and then artificial intelligence technologies can be used as an important tool for recruitment. As studies on artificial intelligence increased, advances in human resources will continue.

17.8 Conclusion

Recruitment activities do not mean only hiring personnel for businesses. As a matter of fact, finding the most suitable person for the position within the scope of many job applications is one of the important building blocks in order to maintain the success of the brand by employing sufficient personnel for the enterprises. However, it is possible to say that the lack of employment of personnel qualified to the desired qualifications will cause developments in the opposite direction of this situation. When the historical course of hiring processes is examined in terms of businesses, it is observed that recruiting is predominant with traditional methods and that recruiting in this direction is quite intensive nowadays. As a matter of fact, with the applications such as written exams, interviews in recruitment processes realized in the form of face to face interviews with these methods, the assessment of individuals is done by different people. However, nowadays, it is observed that artificial intelligence is used in terms of recruitment processes under technological developments and these developments. With artificial intelligence, human resources such as recruitment or dismissal practices, performance evaluations, training and orientation processes, career management and coaching have started to be managed more efficiently both financially and in terms of time compared to traditional methods.

Artificial Intelligence technology can increase the probability of perfect matching, even at the beginning of a transaction, by applying algorithms and making predictions that select only the most relevant jobs before showing them to job-seekers. Thanks to these software algorithms, robots decide whether a candidate is suitable for work with factors such as facial expression, voice or words he or she uses.

In addition to the elimination of human prejudice issues during candidate assessment, artificial intelligence adds a lot to human resources departments in terms of easing the workload of eliminating the vast amount of data that make up candidates' CVs, social media accounts, reference letters and other resources. In other words, the use of artificial intelligence in recruitment is not an alternative to human resources personnel, but rather an alternative to the use of auxiliary applications that share workload. However, when the dominant understanding of today is examined, it is seen that artificial intelligence in HR processes has a dominant bias that will disable employees in this area. This prejudice is unlikely to occur. Thus, when job seekers and employers interact with human resources specialists, they feel the sense of trust, loyalty and teamwork. This natural environment is also effective at the point of views of individuals about their workplace. However, it is not possible to copy the stated situation by machines and to create the same feeling. However, those who will determine the recruitment criteria to be included in the applications of artificial intelligence or who will determine the qualifications required in the people who will be in the related position will be the human experts (Doğan & Önder, 2014).

Artificial intelligence can be easily programmed to respond to daily questions in real time, regardless of whether they were created by new or senior employees. These bots can act as self-service platforms that allow human resources personnel to focus on responding to more complex and urgent questions. In the business world, one of the best areas to use artificial intelligence is human resources departments, as in the first place in dealing with the "human" component of companies. In summary, in addition to eliminating the unnecessary burden of human resources personnel, artificial intelligence is seen to help facilitate all these tasks and gain insights into the true performance potential of each candidate and employee.

Artificial intelligence technology for beginners is independent of clichés and the effect of the applicant's race, gender, or ethnic origin on the candidate evaluation outcome. Artificial intelligence software can design relevant interview questions that completely ignore someone's background at the expense of focusing on professional competencies for a particular job. These assessment questions will be based on the applicant's previous work records and, more importantly, on the requirements of the work they apply for.

As a result, it is prevented from wasting time by solving recruitment processes with artificial intelligence. The role of Artificial Intelligence is to provide more time for human resources. In addition, it increases the satisfaction of the candidate, saves the expenses and makes more accurate decisions in finding the most important right candidate. As a matter of fact, at the end of these processes, the candidate is dealing with a human being, but the time has not been wasted for both the candidate and the related human resources specialist.

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Chapter 18
Digital Marketing Strategies and Business Trends in Emerging Industries

Buket Özoğlu and Ayşe Topal

Abstract The digital age in which the Internet is located in the center has initiated a period that completely revised the whole marketing system from using traditional tools to using modern tools. Thus, this has led to the birth of digital marketing. Digital marketing can be defined as the marketing practices carried out by using digital channels such as internet, mobile, and interactive platforms. It provides cost advantage and competitive advantage for businesses through its distinctive features. New industries which bring new developments into economies such as new products and concepts are called emerging industries. There are several difficulties an emerging industry faces while entering into a market such as high costs, uncertainty, complexity, and instability. Traditional marketing may not be effective enough in these industries to deal with these difficulties due to the ongoing transformation in the technology and digital marketing. This is expected to present more useful and effective results. Therefore, the digital marketing potential in emerging industries will be presented in this study.

18.1 Introduction

The new technological revolutionary process in which the Internet is located in the center has initiated a period that has completely revised the whole system from traditional tools to modern tools in the marketing world. Thus, this has led to the birth of digital marketing. This new marketing approach which can be considered as the practices of traditional marketing tools in a 'virtual' or digital environment provides many advantages to businesses. This is due to their distinctive features, as well as many threats due to the inability to adapt or to make changes.

In the most general form, digital marketing can be defined as the marketing practices carried out by using digital channels in a digital environment such as

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internet, mobile, and interactive platforms. The most important benefit of digital marketing is seen as cost advantage from an economic view. However, it can also provide competitive advantage through its distinctive features such as simultaneous interaction with target group, updatability, flexibility, creativity, and openness to innovations.

The area where digitalization first appeared in marketing has undoubtedly been communication. Digitalization has made the biggest revolution in marketing with the effect of virtual communication channels on marketing communication which is one of the four basic elements of traditional marketing. There is a unilateral flow and communication between the producer and the consumer in the traditional marketing concept. Nevertheless, a double-sided and constantly renewing communication process has emerged on digital marketing depending on the developing technologies and the opportunities provided by the Internet. Therefore, the institutions differing from using the usual forms of the system in marketing applications and marketing tools have directed the design and operating processes of the producer-consumer network into the digital through opportunities provided by digital world. Digital marketing has significant advantages in many respects such as digital media campaigns, the speed of transformation of these campaigns, low costs, and instant and effective communication with consumers which is not only limited to marketing communication. Furthermore, it has also made a difference in many aspects of marketing.

Traditional marketing activities are planned in accordance with mass production. It has been seen that mass production does not meet the consumer wants anymore as they want more personalization in products. The industrial revolution we are in now, called Industry 4.0, is suitable to meet these demands of consumers.

Industry 4.0 and accompanying digitalization enabled personalized production. On the other hand, digital marketing provides an environment where consumers' expectations are understood and transferred to the production process and the results are delivered to the consumers. With the creation of digital products, differentiation of the distribution channels of these products, distribution management and logistics activities which has been made easy through the opportunities provided by technology, and creation of new business opportunities for intermediaries in the distribution channels are the first changes that can be mentioned in digital marketing. Also, digitalization has increased the effectiveness of marketing information systems. It has created great benefits in the processes of collecting, processing, and evaluating data related to consumers. It also has enabled an effective audit system for measuring the results of marketing activities. Therefore, the digital marketing management is a more proactive approach that provides rapid feedback. This enables the necessary interventions and improvements in each phase of marketing process such as planning, implementation, and supervision.

Digital marketing basically consists of four steps: acquire, convert, measure-optimize, and retain-grow (Bektaş, Demirel, & Ölmez, 2017; Bulunmaz, 2016; Çözen, 2011; Koçak Alan, Tümer Kabadayı, & Erişke, 2018):

- In *acquire step*, the activities that are used to attract the consumer to the website or the page where the sales take place are discussed. The main tools of acquisition are viral marketing, search engine optimization (SEO), social media marketing, mobile marketing, e-mail marketing, and revenue partnership.
- *Convert step* is important to win consumers who entered the website. There are several activities to win consumers. These are usability and accessibility studies, strengthening the mechanisms that support the customer decision, content management, increasing the usefulness of the website, making convincing messages in the sales texts, personalizing according to the customer, grouping the customers, and focusing on these groups effectively.
- *Measure and optimize* step is the most important stage in digital marketing. Tests and analysis are used to support the business to measure its success, to understand what it is doing right and wrong, and to compare itself with competitors.
- The aim of *retain-grow step* is to satisfy the existing customers and to provide the best service to them. The techniques that can be used in this step are: e-mail marketing, pricing strategies applications, personalization, loyalty programs, reference programs, and community building.

New industries which bring new developments into economies such as new products and concepts are called emerging industries. In the beginning of the twentieth century, automotive industry was an emerging industry and internet was an emerging industry in 1980s. European Cluster Observatory identified key emerging industries under seven categories: creative industries, eco industries, experience industries, maritime industries, mobile services industries, mobile industries, and personalized medicine industries.

There are several difficulties an emerging industry faces while entering into a market. For example, emerging industries are faced with high costs when entering the market. The cost of developing a new product or concept is quite high due to research and development costs. This leads to uncertainty and as a result risk are high for emerging industries. Due to the new development, complexity is involved in all operations of these industries. Marketing expenses is also another difficulty encountered by emerging industries as the developed product or concept is unknown in the market. Therefore, this requires convincing consumers to buy and investors to invest. However, emerging industries have high return potentials despite all those difficulties. As the market is not mature yet, there will be a chance to grow quickly for companies in a given emerging industry. Also, it has been seen that personalized products are densely produced in emerging industries. For these reasons, traditional marketing is not effective enough in these industries and digital marketing is expected to be useful and effective. Therefore, the digital marketing potential in emerging industries will be presented in this study.

In this study, reflection of digital revolution into marketing field will be discussed conceptually and digital marketing strategies will be mentioned. The changes and innovations that digital marketing brings will also be discussed. Emerging industries will be defined and the difficulties they faced which are different from traditional industries will be presented. Finally, we will discuss digital marketing in emerging industries.

18.2 Digital Marketing

The digital world with around four billion Internet users worldwide (International Telecommunication Union, 2018; Internet Live Stats, 2018) is growing and developing irresistibly. Marketing is basically about people not technology. Technology has increased its importance for marketing as it facilitates more effective communication between people (Ryan & Jones, 2014). The effects of innovations brought by digitalization on every aspect of human life are inevitable for the marketing function of businesses which is the most closely related business function to human. Digitalization and social media in particular have led to a shift in consumer behavior (Kaplan & Haenlein, 2010). It cannot be denied that the effects of digitalization are a revolution for marketing, whether in terms of consumer behavior (Kannan & Li, 2017) or in terms of fundamental marketing components or marketing information systems. This is derived from the dynamic nature of human being, which is one of the basic elements of marketing. As in all branches of science, marketing science needs to adapt to the recent developments and adjust these developments to its activities.

People can access information faster and more easily through the benefits of digitalization and the capabilities of the digital world. Research has shown that 80% of internet users reach information through search engines (Metin, 2016). Gathering information about options that are one of the stages of the purchasing decision process can be carried out faster and with less effort. Digitalization gives consumers a chance to reach each option and to make a comparison by collecting the right information about them. This situation, which empowers consumers, makes effective digital marketing activities compulsory.

Digital marketing has been defined by American Marketing Association (AMA) as "*activities, institutions, and processes facilitated by digital technologies for creating, communicating, and delivering value for customers and other stakeholders*" (Kannan & Li, 2017). It is an innovative technology-based marketing that enables interaction between a company and its customers (Skudiene, Auruskeviciene, & Sukeviciute, 2015). On the other hand, Chaffey, Ellis-Chadwick, Mayer, and Johnston (2016) defined digital marketing as the use of digital technologies and Internet together with traditional communication channels to achieve marketing goals. Accordingly, digital marketing requires using all digital channels and tools to manage it in an integrated manner with traditional marketing activities. Digital marketing is not only utilizing traditional marketing with digital tools, but it is also a novel initiative for marketing (Järvinen, Tollinen, Karjaluoto, & Jayawardhena, 2012; Liu, Karahanna, & Watson, 2011; Rowley, 2008; as cited in Taiminen & Karjaluoto, 2015). Digital marketing provides an environment for businesses to create and maintain a value for all parties involved such as customers or partners through digital tools (Kannan & Li, 2017). Furthermore, digital marketing is also named as web marketing, e-marketing, online marketing, interactive marketing, and internet marketing.

Marketing activities carried out in the traditional environment need to be stopped at the end of the day and at certain times. It is also important that a well-developed digital marketing strategy ensures that online marketing processes continue to operate 24 h a day and 365 days a year. Continuity of marketing activities through digital environment is a miracle as regards traditional marketing. Naturally, in today's destructive competitive environment, businesses want to make use of this miracle as much as possible.

18.2.1 Historical Development of Digital Marketing

The development of digital marketing is simultaneous with internet history. It can be said that digital marketing appeared with the introduction of computers and internet in consumers' homes in the 90s (Gökşin, 2018; Kingsnorth, 2016). In order to explain the development of digital marketing, it is necessary to mention Web 1.0, Web 2.0, and Web 3.0. Web 1.0 refers to the period in which the static information that consumers can acquire on their web pages takes place (Gökşin, 2018). Interaction was low and, unlike the present situation, it did not involve real human communities (Kingsnorth, 2016).

In 1994, the digital marketing had a milestone with AT&T's clickable banner ad on hotwired.com (Gökşin, 2018). In the same year, the first network explorer called WebCrawler (search robot, web robot) was created. These had formed the basis of modern search engine optimization (Kingsnorth, 2016).

The introduction of Google into the search engine market in 1998 and the launch of Blogger in 1999 initiated the modern Internet era (Kingsnorth, 2016). In the middle of the 90s, collecting information from consumers can be mentioned as one of the important milestones by means of browser-based cookies (Gökşin, 2018). In this period, the businesses that entered fast to electronic commerce activities were not able to obtain the profitability ratios they expected because the consumers were not ready for the idea of shopping on the internet. This situation, which was shown as one of the most important reasons for the Internet Balloon crisis in 2000, resulted in the closure of many internet companies (Gökşin, 2018). The emergence of MySpace, which is the starting point of social media, can also be expressed as one of the important steps despite the failure (Kingsnorth, 2016).

There was no major technological development phase in Web 2.0 as its name evoked. Although it was used for the first time in 1999, it has become known since 2004. Web 2.0 has made a difference in the way the websites are created. With Web 2.0, users can also generate content. Users can create content and upload them to the web site, so that they can interact with other users in this way (Gökşin, 2018). This difference, which seems to be small, has led to an important marketing result because it has transformed websites into social environments (Kingsnorth, 2016).

Web 3.0 is defined as the next-generation web which helps searchers to perform complex tasks of supplier selection. It also includes intelligent or semantic web where automated applications can enter data from different online services, high-speed connectivity, and complex cross-community interaction (Chaffey et al., 2016).

18.2.2 Digital Marketing Advantages, Disadvantages, and Challenges (Challenges in Digital Marketing)

The most important digital marketing channels and tools are: Internet media channels, mobile platforms, and social networks. In developing traditional marketing into digital marketing, developing technology, close interaction of Y and Z generations with technology and new consumption patterns (channel utilization) due to this interaction, as well as digital channels and tools have enabled marketing activities to be carried out more effectively.

The change of consumer behavior due to the Y and Z generation can be defined as new generation consumers sustaining their lives in virtual environments and among new generation devices. More so, the spread of this change to other consumers are the most important factors triggering digital marketing. The increasing importance and place of mobile devices in human life, and the usability of these devices together with applications such as social media, mobile applications, and advanced analytical capabilities, have allowed consumers to reach unlimited information (Smith, 2011).

On the other hand, digital marketing results in market segmentation, target market selection, and measurement of activities which are easy for businesses. It also facilitates carrying out marketing activities effectively and efficiently. These are a few advantages that digital marketing provides to businesses.

By means of digital marketing tools, it is possible to reach the target markets with less cost and in less time and to find the information needed by carrying out marketing communication activities suitable for the target market. The main advantages of digital marketing are: not wasting the expenses by transmitting the marketing messages through digital channels to the target audience, and being able to measure the results with the determinants such as the number of views.

Another advantage of digital marketing is the possibility of interactive communication with consumers. The feedback from consumers is very important in traditional marketing. However, the intermediaries in the communication channels of traditional marketing did not provide adequate and accurate information to the businesses due to the various disruptions and the lack of interactive communication. Through digital marketing and digital channels, businesses and consumers are able to communicate in an interactive manner, get instant information about products, and deliver their problems and opinions. The fact that today's consumers prefer instant and interactive communication favors digital marketing transformation. In addition, digital marketing enables interactive feedback from customers to create a sincerer environment in relations with customers, to increase the level of knowledge, to develop connections with internal and external environment, to support decision-making process, and to increase efficiency (Tiago & Veríssimo, 2014). With the opportunities provided by the digital environment, businesses present their products to a wider market, manage their sales and orders, manage the after-sales customer relations, and provide an environment through which consumers can share their opinions easily and interactively (Wymbs, 2011).

In addition to its many advantages, there are various disadvantages of digital marketing and the difficulties that businesses face in digital marketing applications. The fact that digital marketing is an internet based marketing activity makes it accessible to all internet users. Accessibility through internet provides various advantages to the businesses in terms of interaction with consumers. Nonetheless, it also gives an opportunity to malicious parties for abuse. It opens a door to many misuses, ranging from counterfeiting new products, brands, logos, and digital marketing activities, exploiting web sites or social media accounts (hacking) to accessing databases to acquire consumer information. This causes loss of reputation, loss of customer and financial loss for businesses, loss of trust, loss of privacy, and financial loss for customers. There are various measures that businesses can take against these disadvantages. On the other hand, there are also criminal and dissuasive regulations introduced by state and international law. For example, there are legal and copyright regulations for the protection of new products, brands, and logos of businesses. Also, legal arrangements have been made regarding the protection of customer privacy and information. In addition, businesses are taking protective internet measures for their internet-based activities. Another disadvantage is that digital channels are less preferred than traditional tools, especially by the consumers over a certain age as they prefer to examine products by touching them before buying (Smith, 2012). The decision to buy without touching the products and without a real interlocutor causes the risk perception of consumers to be high.

Difficulties in digital marketing management are encountered in the following issues; the lack of plans and strategies for digital marketing despite businesses which are actively involved in carrying out digital marketing activities, the difficulties experienced in evaluating the return on investments in digital marketing activities despite the fact that businesses are aware of the importance of digital marketing activities, and the integration of digital marketing with traditional marketing activities (Chaffey et al., 2016).

In order to meet the changing consumer demands and needs, benefit from the advantages of digital marketing, and to eliminate the difficulties encountered during the digital marketing management, businesses should use the digital marketing tools with the right strategies. It is important for businesses to determine appropriate digital marketing strategies for efficient use of resources and to make the best use of the benefits offered by the digital world.

18.3 Digital Marketing Strategies

Digital marketing is the last point reached in digital commerce activities which started in 1989 with the birth of the Internet. Digital marketing is necessary for businesses in the current timeframe to maintain their positions in a harsh competitive environment equipped with digital tools. Digital marketing is a multi-channel strategy which leads to making complex resource and process decisions without knowing how consumers will react (Frishammar, Cenamor, Cavalli-Björkman, Hernell, & Carlsson, 2018). In particular, the applications described as digital marketing channels or tools in a variety of sources with a practitioner perspective are considered as digital marketing strategies. Digital marketing applications also need to be managed strategically. For this purpose, businesses need to make a general and exponential strategic planning on the extent of how they will benefit from these practices. From a general management point of view, the digital marketing strategy is addressed by Kannan and Li (2017). This explains how to strategically manage the two core marketing elements, their brand and customers, which the company focuses on to achieve a sustainable competitive advantage by using digital channels and tools in an ever-changing digital environment. Digital marketing strategy is a comprehensive approach along with status assessment, goal setting, strategy formulation, and resource allocation and monitoring which evaluates how digital tools can be adapted to business and marketing operations (Chaffey et al., 2016).

In order to manage digital marketing activities effectively, businesses need to create original content that is suitable for targeted consumers and shape the process of sharing this content in a digital environment in a correct and effective manner with a strategic point of view (Bulunmaz, 2016). The ability to manage digital marketing from a strategic point of view requires developing new interactions with customers through using new channels and new shopping tools, a modernized approach to customer management and brand management, re-describing metrics of the marketing mix, and Customer Relationship Management (CRM) (Kannan & Li, 2017).

To benefit from the advantages of digital marketing and to overcome difficulties, businesses need to develop a well-planned and structured approach (Chaffey et al., 2016). Digital marketing activities mentioned below, which are extremely diverse and have not yet been developed, should be carried out with a strategic management approach.

Digital marketing strategy involves carrying out all traditional marketing approaches such as consumer segmentation, target market selection, positioning, and the value proposition offered by the businesses to the consumers through the digital marketing perspective which is a multi-channel strategy (Chaffey et al., 2016). Digital marketing strategy can also be defined as situation analysis, defining goals and objectives, and strategy formation. These are also the fundamental elements of strategic approach.

An effective digital marketing strategy (Chaffey et al., 2016);

– Comply with business and marketing strategies.
– Use clear goals for online promotion, forwarding, and other digital channels.

- Is compatible with the type of customer using digital channels and effectively accessible via channels.
- Define a value proposition suitable for transmitting to customers via digital channels.
- Specify the digital marketing tools which the business or brand will benefit from and indicate the extent they will benefit.
- Support consumers throughout the entire process when using digital tools and shopping through digital channels.
- Manage the customer life cycle by using all digital tools throughout Acquire, Convert, Measure & Optimize, and Retain & Grow stages.

Stages of a general digital marketing strategy process include (Chaffey et al., 2016; Chaffey & Smith, 2013);

- Performing a digital based SWOT analysis by taking macro and micro environment into account during the situation analysis,
- Determination of basic digital marketing targets for digital channels and tools,
- Determining how to achieve targets including market segmentation, target market selection, positioning, and marketing components at a strategic level,
- Constructing the tactical level of digital tools,
- Development of action and action plans,
- Ensuring the level of achievement of the goals set for digital marketing and the control of the success of the strategy.

18.3.1 The Digital Marketing Process

Digital marketing consists of four basic stages: (1) acquire, (2) convert, (3) measure & optimize and (4) retain & grow (Bektaş et al., 2017; Bulunmaz, 2016; Çözen, 2011; Koçak Alan et al., 2018).

- *Acquire*: This step can be defined as the business attracting consumers to the website through a variety of digital tools or to any digital channel that it can sell. Acquire can be achieved in the form of consumers reaching the sale sites of businesses through viewing a video on any subject that interests consumers, clicking on a link on the page, an ad link to the e-mail address, or any activity in a digital environment. This can be realized as businesses reach sales sites. Some of the tools used to acquire the consumers are email marketing, social media marketing, content marketing, viral marketing, search engine ads, and affiliate marketing.
- *Convert*: This involves all the activities carried out to direct the consumers who have come to any digital channel in which they can process their sales to the website of businesses through the tools in the acquire stage of acquisition. Some of these activities can be defined as facilitating transactions in a way that supports customers' purchasing decisions, content management, personalizing according

to customer, giving convincing messages in accordance with business objectives, and focusing on the target consumer group (Chaffey et al., 2016). For every business or digital marketing platform, the objective may not be carrying out the sales transactions. Frequent visits of the website, access to more users, dissemination of ideas or information can also be targeted on digital platforms. The objectives of the non-profit organizations, political parties, and individual blogs can be given as examples to the non-sales objectives.

- *Measure & Optimize*: At this stage, the businesses get the results of all the activities and compare these results with the competitors. It is an important stage in terms of how decisions such as to what extent the activities carried out at all other stages are properly managed and how to conduct planning in the following stages. In order to evaluate whether they are successful or not, businesses need to measure the efficiency of their activities and optimize these activities in order to be successful in the future. There are various ways in which businesses can measure their digital activities. One of these is the Google Analytics service offered by Google. Through this kind of services, businesses can obtain information about the success of their websites and the success of the various activities they use to acquire consumers. Hence, they can re-plan the activities they use according to the results.
- *Retain & Grow*: Since it is known that the costs incurred by businesses to acquire new customers are much higher than the ones they will bear to keep the existing customers, it is therefore important to maintain the current customers' satisfaction in digital environments also. At this stage, personalization, creating solutions to develop customer loyalty, establishing an effective customer relationship management system, digital response systems, and loyalty programs are among the activities that can be carried out by the businesses in the digital environment.

18.3.2 Digital Marketing Tools

The most important digital marketing tools are e-mail marketing, Social Media Marketing, Content marketing, Viral Marketing, Affiliate Marketing, Influencer Marketing, Mobile Marketing, Search Engine Optimization (SEO), Search Engine Marketing (SEM), and Application Store Optimization (ASO). While there are some studies in the literature that sort these tools individually (Leeflang, Verhoef, Dahlström, & Freundt, 2014; Tiago & Veríssimo, 2014), there are others grouping them (Key, 2017; Piñeiro-Otero & Martínez-Rolán, 2016) together. For example, Piñeiro-Otero and Martínez-Rolán (2016) grouped the search engines such as SEO and SEM under Web Search Marketing and explained that Web Search Marketing comprises of SEO, SEM, and keyword selection for optimization.

E-Mail Marketing E-mail marketing can be described as sending advertising messages by e-mail to the target audience. E-mail marketing has been used since the first e-mail sent in 1971 (Piñeiro-Otero & Martínez-Rolán, 2016). Although it has been used more intensively in the first years and has lost its importance and frequency of use, it is still an effective digital marketing strategy when it is used to deliver personalized messages to the right audience. Email marketing enables communication with consumers on a personal level (Ryan & Jones, 2014).

It can be said that the effect of e-mail ads on purchase decisions is more than social media messages. However, one of the issues that should be considered for the success of e-mail marketing is that the e-mail messages sent to the consumers must be compatible with the mobile devices consumers are using because most consumers access their e-mails from mobile devices. Attention must be given to the frequency and accuracy of the messages sent. Message should be delivered by e-mail in a language and style appropriate to the target consumer and with a message to express value for consumers. Consumers will read e-mails from the known brands which they are customers with an expectation that they have a prominent and interesting offer (Ryan & Jones, 2014). In addition, the consumer must be given the right not to be exposed to messages from the business and it should be ensured that they can easily unsubscribe from receiving messages. When the value proposition offered by the businesses to the consumers decreases, the consumers will use unsubscribe, they will exit the e-mail mailing lists and they will not be turned back (Ryan & Jones, 2014). Another important issue in email marketing is the personalization of messages delivered to the consumers. Personalization has become much less costly and rational than in the past through digital marketing tools (Piñeiro-Otero & Martínez-Rolán, 2016). On the other hand, consumers' expectations about personalized products and messages have increased. E-mail marketing provides businesses with a wide range of opportunities to deliver personalized messages. By making e-mail marketing interactive, even problems encountered in the personalization of messages can be reversed.

Having very low cost (Ryan & Jones, 2014), calculating the profit more easily than other tools, being able to reach all consumers who are e-mail users, being able to deliver the personalized message desired to be delivered to the right audience are amongst the most important advantages of mail marketing. It is an important and valid tool since it can be carried out easily, deliver instant messages, a high-return tool when performed correctly (Ryan & Jones, 2014), and used in consumer offers such as giving information about discounts.

Despite the advantages, starting e-mail marketing can be blocked due to antispam filters that identify email messages as spam, so this is reducing the effectiveness of digital marketing tool (Piñeiro-Otero & Martínez-Rolán, 2016). On the other hand, in accordance with the legal regulations made by the states, sending unauthorized e-mail to the consumers may result in various penal sanctions. Giving authorization to businesses for registering consumers to the e-mail database and send them e-mails is known as permission marketing.

As with other digital marketing tools, businesses need to control metrics in their e-mail marketing activities. The rates related to the failure of the e-mails sent, the rate of emails read by consumers, the rate of clicks to the links in emails, and the rate of consumers unsubscribing must be followed by the businesses and plans are made according to these metrics.

Social Media Marketing While social media is a structure that enables people to communicate with each other in a digital environment, they have gained importance in terms of intensive use by consumers and evolving needs and marketing activities. Social media is a tool used by businesses to communicate with existing customers, gain potential customers, and maintain brand awareness and image (Mills, 2012). Social media marketing can be defined as activities that will enable communication with the consumer in all social platforms where the target audience is. Social media marketing is an interdisciplinary and cross-functional tool which aims to create value for all parties taking part in the trade by using social media, and it consists of decisions about the scope, culture, structure, and governance (Felix, Rauschnabel, & Hinsch, 2017). Although businesses see their social media channels as a medium in which they communicate their messages and provide promotional activities, in a short time social media has gone beyond this. Social media has provided a more active role for consumers in the marketing with the necessary tools that enables them to share their opinions and form a content about products or services, which required businesses to take a place in conversations and use the channels in social media proactively (Piñeiro-Otero & Martínez-Rolán, 2016). Social media has influenced the customer value not only based on purchasing but also based on social interactions; and has reshaped CRM strategies (Kannan & Li, 2017).

Although social media marketing started with social networks (Facebook, Instagram, etc.), many digital platforms such as microblogs (Twitter), live broadcast channels (Periscope), content sharing platforms (YouTube, Vimeo), message applications (WhatsApp, Skype), broadcast platforms (dictionaries, blogs), and game sites have been included within a short period of time (Bohur & Kirali Eryilmaz, 2015; Güzel, 2012). The diversity of these social platforms and the necessity of addressing different target audiences with different options have forced businesses to choose and determine the right strategy. Information, about which social networks are used by which consumers, and for what purposes, helps businesses to develop the right strategy.

Content Marketing It is an alternative tool which was created to handle the negative reaction of the consumers to the advertising messages. It is not intended for direct selling, but it emphasizes the positive features of the product inside the content. While content marketing has been used by businesses for years in traditional marketing, the distribution of this content is handled through digital media (Ryan & Jones, 2014). Instead of digital advertising made with traditional advertising tools, it has tried to attract consumer attention by transmitting messages in a new format. Businesses try to attract consumers with content that will give information about the use of products, different uses and value that products can provide. Content marketing consists of the activities related to creating valuable content and distributing it through the media aimed at attracting, obtaining, and keeping the target audience for the purpose of reaching the profitability target of the enterprise (Baltes, 2015).

Content marketing makes digital marketing tools such as social media marketing, search engine marketing, and search engine optimization more effective (Ryan &

Jones, 2014). With content marketing, the website is visited more frequently, ranked higher in search engines, and useful content are shared more on social media.

Viral Marketing Viral marketing is a strategy that directs consumers to share product-related messages with other consumers in a digital environment and thus reach the potential consumers with an increased acceleration (Cruz & Fill, 2008). It can be expressed as a kind of word-of-mouth marketing activity in a digital environment that enables the promotion, purchase or recall of products. Viral marketing can also reach people in a similar way to the computer virus which can affect all computers connected to a network by taking advantage of the internet (Chaffey & Smith, 2013). In viral marketing, there are two basic situations in which there is an intervention on the content by the business or not. Businesses can create professional content for their viral propagation or content is created by the consumers.

While viral marketing is found to be reliable by consumers due to the lack of any intervention and control of businesses in the process of creating and disseminating content, it is a tool that can cause problems for businesses like negative campaigning (Bagga & Singh, 2012; Levy & Gvili, 2015).

Affiliate Marketing Affiliate marketing is a tool that the sales partners contribute to the sales by promoting the products in digital media. In other words, it is a digital marketing tool used by sales partners to share in the profit over the products they affiliate. AMA explains affiliate marketing as a type of marketing where there is a payment to a third party for each visitor or customer they directed to the business (AMA, n.d.). Affiliate websites provide secure environment to customers with custom payment options and warranties. With this tool, businesses reduce the costs by transferring marketing communication to sales partners. Sales partners also guarantee a profit from sales. In this tool, also known as revenue partnership, there are three types of payment methods: Cost-Per-Lead (Cpl), Cost-Per-Sale (Cps), and Cost-Per-Click (Cpc) (Broussard, 2000).

Influencer Marketing Influencer marketing is the transmission of the contents to be delivered to the target audience or the products to be introduced to the consumers through the people who are famous in social media or who can be considered important in the digital social world. Influencer marketing is explained by AMA (n.d.) as marketing where few influential individuals such as social media celebrities, activists, academics, bloggers, and other trendsetters medium in reaching target audience.

It is a digital marketing tool that enables social media celebrities, who have high number of followers in social media channels, to comment on products and brands and share their knowledge and experiences about them in various social media environments. Research shows that consumers are more confident about the information they obtain through this way. Businesses pay to high bloggers or social media users who have high number of followers to talk about their products, to share their experiences with their products, and to add product photos and make positive comments.

Mobile Marketing In recent years, users replacing of desktop and laptop computers with mobile devices and shifting their internet access to mobile have led to direct businesses of mobile marketing. Consumers use mobile devices in most of the time they spend online. Mobile marketing consists of applications that provide businesses with the opportunity to interact with audiences through all mobile devices and networks, and to acquire customers (Ryan & Jones, 2014). It is inevitable for businesses to carry out their digital marketing activities through applications that are widely used in mobile devices. Mobile marketing is the adaptation of digital marketing to the mobile technologies that enable people to access 7/24 and to make the whole process easier while on the move. The effectiveness of mobile marketing tool depends on (Ryan & Jones, 2014):

– Reducing the number of clicks and simplifying all processes from the beginning to the end,
– Adapting all processes to touch screen instead of keyboard and mouse,
– Fast, dynamic and reactive design suitable for mobile devices,
– Providing search optimization for finding of mobile content easily,
– Measuring consumer behavior in order to understand the effectiveness of mobile channels and the return on investment, as in other digital marketing activities,
– Prioritizing the use of internet and mobile devices with high online traffic,
– Optimizing social media channels for mobile devices,
– All content that is directed to mobile devices is compatible with these devices.

Search Engine Optimization (SEO) The most comprehensive and important digital marketing resource for businesses is web sites. A way for consumers to be informed about businesses in a digital environment is the search engines that Internet users use to find an object, information, or product. Today, the most widely used and known search engines are Google, Bing and YouTube. Regionally used search engine options are also available. Taking the high rank in these search engines, which provide links to the websites of the businesses' products and all its digital content, is extremely important and even necessary for making consumers to be aware of their businesses and products. The activities carried out in order to place the websites of the companies in the top ranks in the search engines are called Search Engine Optimization. A number of specific combinations of keywords entered by the search engine user allows access to the top rank in the organic search results (Chaffey et al., 2016). Users prefer the top ranked web sites in search engine results. Hence, Search Engine Optimization is an important digital marketing tool in order to make the websites of the businesses more likely to be visited by the users.

Search engines perform ranking according to an algorithm and certain factors or signs they determine. Google states that it uses over 200 factors or signs in the ranking algorithm (Chaffey et al., 2016). The popular web site links according to these algorithms are placed at the top of the rank (Giomelakis & Veglis, 2016). According to the assessments made before the widespread impact of social media, two factors that are most effective in Google's search engine ranking are specified as the web page-keyword relationship and the incoming returning links to the page (Chaffey et al., 2016). However, the increasing importance of social networks and content marketing in recent years and the interest of consumers in qualified content have updated the determinants of being listed in the search engines as mentioned in social networks and links shared.

Being popular in social media and the links shared frequently in various digital environments makes the website to be ranked at top in the search engines, organically. Being shared by influencers, who have a high number of followers in social media, undoubtedly increases the effect of the popularity by multiplication. The more the business content, products, brands and website links are seen in the social networks, the higher rank in the search engines, and the higher the chance of being noticed by so many potential consumers.

Search Engine Marketing (SEM) Search Engine Optimization is a time-consuming digital marketing tool for businesses to move their website to the top ranks in search engines. In some circumstances for businesses, Search Engine Optimization may not be fast enough desired by the business as it takes some time to build popularity online and then climb the rank. In this case, Search Engine Marketing can be an alternative digital marketing tool to move the business website to higher rankings in search engines. Search Engine Marketing is the direct placement of a business into the top rank by paying to search engines. When a search engine user enters a specific phrase that may be associated with the business products or brands, the search engine results show a referral to the business's website at the top. Search Engine Marketing is used to increase the potential of visiting the website periodically and to ensure high efficiency in the marketing activities during campaign periods or in terms of periodical marketing.

Application Store Optimization (ASO) It can be expressed as the adaptation of Search Engine Optimization to mobile devices. With the expansion of the mobile device users, businesses need to adapt themselves to the applications used in smart mobile devices besides traditional website search engines. The search engines are the App Store for Apple devices and Google Play for Android devices. Similarly, the applications, which are more downloaded, recommended and have a positive opinion, are likewise preferred.

18.3.3 Digital Marketing in Traditional Industries

Recent developments in internet and information technologies have led to a serious change in competition conditions. All companies in the economy were affected by these changes and the businesses entered into a transformation process.

Amazon, for example, has emerged as a gigantic power that completely changed the competitive environment by using the online channel in the retail sector (Kannan & Li, 2017). Travel agencies are another example that strengthens its competitive position in the travel and hospitality sector against hotel chains by utilizing mobile applications (Kannan & Li, 2017).

In line with the opinion that retailers will benefit from using shopping analytics and multi-channel strategies, businesses in the retail are beginning to use sensors for analyzing consumer behaviors and to provide costumer online order option inside the stores and home delivery (Frishammar et al., 2018). On the other hand, using social media for communication purposes in marketing will be beneficial for the businesses in terms of increasing the brand loyalty and information reliability (Roblek, Bach, Meško, & Bertoncelj, 2013).

18.4 Digital Marketing in Emerging Industries

In this section, we will first define emerging industries and then address some theoretical challenges and trends associated with the emerging industries in terms of marketing.

18.4.1 Emerging Industries

New industries which bring new developments into economies such as new products and concepts are called emerging industries. Emerging industries appear when opportunities are caught by entrepreneurs and resources are transferred to finance this opportunity (Aldrich & Fiol, 1994). There are three stages in the life cycle of industries, which are emergence, development, and decline. Emerging industries are basically in the earlier stages of development known as emergence (Forbes & Kirsch, 2011; Low and Abrahamson, 1997).

Schumpeter's and Marshall's studies (as cited in Krafft, Lechevalier, Quatraro, & Storz, 2014) stated that an emerging industry is born just after a new technology or a new knowledge has emerged. For example, automotive industry was an emerging industry in the beginning of twentieth century as a result of gasoline engine invention and internet was an emerging industry in 1980s with information technology knowledge.

There are several common characteristics of emerging industries listed by Monfardini, Probst, Szenci, Cambier, and Frideres (2012) as shown below:

- It is established on the novelty concept in which the basis is new products or services,
- It is research and knowledge intensive,
- It amplifies entrepreneurship and an innovation,
- It leads to a change in the market structure,
- It emerges from a disruptive idea that impacts value chains,
- It has a high tendency to cluster.

European Cluster Observatory identified key emerging industries under seven categories: creative industry, eco industry, experience industry, maritime industry, mobile services industry, mobile industry, and personalized medicine industry (Monfardini et al., 2012).

Creative Industry This industry involves companies producing a product or service which has a significant creative or artistic element such as advertising, architecture, broadcast media, design (fashion, graphic, interior design, product design), software, film, the "finer" arts (literary, visual and performance arts), libraries, museums, heritage, music, photography, crafts, which are significant intellectual property (Power, 2011).

Flew (2002) listed creative industry characteristics as:

- There is high uncertainty about demand because buyers do not have enough information before buying and experiencing. Therefore, demand depends largely on subjective and intangible customer satisfaction;
- Although demand depends largely on subjective and intangible customer satisfaction, performance of business functions such as marketing and accounting affects the economic viability of creative goods and services;
- The need to employ a creative team with diverse skills and diverse interests lead to diverse expectations about the final creative goods and services which may lead to conflicts;
- Variety of creative products are limited only by the creativity in the mind which is almost infinite but have a limited time to organize various creative activities;
- Creative products have a long life cycle and they may provide profits long after the production such as copyright payments.

Eco Industry Eco industry is also named as "green industry" or "environmental industry". It has been defined by European Environment Agency as involving companies which produce goods and services to reduce ecological pollution (Eco industry [Def. 1], n.d.). It is also defined by OECD—Eurostat as "*those [identifiable] sectors within which the main—or a substantial part of—activities are undertaken with the primary purpose of the production of goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems*" (as cited in Dervojeda, Nagtegaal, Lengton, & Datta, 2013a).

Companies working in waste management, noise controlling, renewable energy, recycling, water management, and soil management ecological urban construction are examples of companies in eco industry. These companies aim to decrease the pollution done to the environment covering all areas in the eco-system such as water, air, soil, waste, and health.

Eco industry has a crucial role in environmental part of the sustainable development. It is a byproduct of sustainable development. Sustainable development is defined first in the Our Common Future report by the Brundtland Commission in 1987 as "*the development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (Brundtland, 1987). To achieve this aim, sustainable development targets to balance economic, environmental and social effects of any activity.

It has become a major industry in Europe in the last decades. European economy gained an annual turnover of over €302 billion in 2015 and eco industry contributed to about 2.0% of the EU's Gross Domestic Product (GDP) (EUROSTAT, 2018).

The eco industry characteristics are (Dervojeda et al., 2013a):

– There is diversity in eco industry where companies are operating in various technology intensive businesses such as renewable energy or pollution filtering to applications such as recycling;
– They were mainly born from traditional and mature industries such as renewable energy industry, where fossil energy suppliers begin to operate in renewable energy;
– Growth and performance in eco industries are related to the legal (environmental) regulations more than traditional industries;
– Technology is a significant driver for eco industry;
– It has customers from both private and public sector, and individual or institutional customers;
– There is a growing public financial support worldwide for eco industry.

Emerging Maritime Industry Historically, maritime industry involves the shipping, fishing and off-shore energy facilities. It comprises all companies facilitating in the businesses related to sea directly as design, construction, operating, supplying, repairing and/or maintaining of ships, or indirectly such as equipment and services (Fiksdahl & Wamstad, 2016; Marlyana, Tontowi, & Yuniarto, 2017).

As an international industry, the maritime industry is highly affected by the global trends worldwide (Stopford, 2003). Therefore, recent global developments in technology and environmental concerns also affected maritime industry and a new emerging maritime industry came into the scene. Emerging maritime industry produces innovative goods and services for the use of traditional maritime industry to increase efficiency and to prevent environmental pollution such as filtering applications, robotics and Internet of Things (IoT). Off-shore renewable energy is another segment in emerging maritime industry, specifically off-shore wind power plants. While it has been quite a time working on off-shore oil and gas power plants, off-shore renewable energy such as wind and wave has been given attention just few decades ago after understanding its potential.

Emerging Mobility Industry Mobility industry traditionally consists of companies who produce goods and services to support the movement of goods and people by using different transport modules such as car or plane. The emerging part of the mobility industry comes from aiming to achieve efficient use of resources, specifically oil, and to decrease the cost and negative environmental impacts of mobility industry activities.

It has been projected by the International Energy Outlook 2016 (IEO, 2016) in its reference scenario that transportation industry will have a 1.4% annual increase in energy consumption which will be 155 quadrillion British thermal units (Btu) in 2040 from 104 quadrillion (Btu) in 2012. International Energy Outlook (2017) stated that the fossil fuel use of transportation sector will increase through 2040, but the share of fossil fuels in total energy consumption of transportation will decrease from 95% to around 88% in 2040 due to the use of alternative fuels such as electricity, biomass, hydrogen and so on (EIA, 2017).

Mobility industry is a significant contributor in terms of greenhouse gas emissions due to the fossil fuel consumption. Increased awareness about climate change directed countries to take measures about greenhouse gas emissions and make regulations about it. This led the environmental friendly new technology being adapted by the mobility industry quickly (Cornet, Mohr, Weig, Zerlin, & Hein, 2012). Electric or hybrid vehicles are example to be given to decrease environmental impacts or new materials or technology used in engines for increasing efficiency and decreasing energy use thus reduce environmental effects. The use of information and communication technology in transports such as in smart vehicles also provides much safety, efficient and environmental friendly option (Pakusch, Stevens, Boden, & Bossauer, 2018).

Mobile Services Industry Mobile services industry consists of companies in the business of operating, infrastructure, retail, distributing, manufacturing, designing and developing of mobile products and services (GSMA, 2018). These companies produces various goods and services such as voice, internet, SMS, text, and other data services in information technology, telecommunication, and entertainment services (Dervojeda, Nagtegaal, Lengton, & Datta, 2013b).

It has been shown by several studies in the literature that mobile services industry has positive effects on social and economic development. Lee (Ed.) (2012) has stated that transition from desktop oriented business environment to data oriented business environment provided new opportunities in the economy due to the advantages of flexibility. Several sectors in the economy such as agriculture and education have benefited from mobile technology through increased economic activity and productivity, improved communication, and social inclusion (Dervojeda et al., 2013b). The use of mobile services has provided a wider ground for business operations through network services, commercial services, and the points of sale (Williams, Solomon, & Pepper, 2012). As a result of increased efficiency and productivity with the use of mobile technology, mobile services industry contributed to a value added around $3.6 trillion worldwide in 2017, which is approximately 4.5% of GDP (GSMA, 2018).

Experience Industry or Leisure Industry These industries present products and services that provide customers with various experiences stimulating different kind of emotions (Dervojeda et al., 2013b). Museums, centers, zoos, parks, or theme parks can be given as an example to the businesses in this industry. Profit in experience industry increases depending on how much the customer satisfied with the experience (Pine, Pine, & Gilmore, 1999). As time is the scarcest resource in today's world, it was defined as the core of experience and leisure by several studies (Brightbill, 1960; Maines, Sugrue, & Katovich, 1983; as cited in Harmon, 2018). Businesses in the experience or leisure industry try to attract consumers' attention with various choices by showing them that they will use their free times effectively as they will have good memories in case they buy (Harmon, 2018).

Personalized Medicine Industry It includes biotechnology, medical and surgical equipment, preventative care, personalized pharmacology and so on (Monfardini et al., 2012). It gathers science and engineering disciplines together and benefits from developing technology in medical procedures. This industry arouse from the fact that every individual has different physical and mental characteristics thus have different and unique medical needs. To deal with the uniqueness of human body in terms of medical trials, medicine industry needed to be adapted to the biologic profile of the individual (Abrahams, Ginsburg, & Silver, 2005). To adapt, it gathers science and engineering disciplines together and benefits from developing technology in medical procedures.

18.4.2 Difficulties Faced by Emerging Industries

All newly established businesses experience various common difficulties such as finding opportunities, providing resources, and institutional procedures. However, due to the fact that a new industry has entirely new conditions, companies in emerging industries are faced with more difficulties than companies newly established in a developed industry. The difficulties faced by emerging industries in the market can be discussed under three categories: uncertainty, instability, and complexity (Aldrich & Fiol, 1994; Clegg, Rhodes, & Kornberger, 2007; Funk, 2010; Gabe, 2005; Jansson, 2011; Tomy & Pardede, 2018):

Uncertainty One of the major problems emerging industries are facing is uncertainty. The reasons contributing to the uncertainty of emerging industries experiences can be categorized under two groups; new technology or knowledge and new business structures:

– The lack of technological standardization increases uncertainty in emerging industries. New technologies or knowledge are tools that have not proved their potential in the market yet. Therefore, to transit new technology or knowledge into a new industry is a complex and risky process and while some companies in emerging industries survive and facilitate later in a developed industry, others fail to succeed and leave the industry in emerging stage. The main reason behind these fails is the difficulty of commercialization. Knowledge is limited in an emerging industry and there are several uncertain situations during the commercialization process such as demand, price etc.
– In the emerging stage of industry life cycle, there is a lack of fully established structural frameworks due to the lack of standardization in business processes such as legal procedures, finance, and so on which increase uncertainty in emerging industries. Industries in the emerging stage do not have industrial legitimacy and, therefore, they are affected more by the liabilities and this increases uncertainty. Also, the high number of businesses entries and leaves leads to uncertainty in emerging industry.

Complexity It is a term defined as "*the state of having many parts and being difficult to understand or find an answer to*" by Cambridge Advanced Learner's Dictionary & Thesaurus (Complexity [Def. 1] (n.d.). It makes facilitating any activity difficult and it is quite high in emerging industries due to the involvement of new technology and the several parties such as various companies specialized in different areas, government and society to manage the introduction and development of new industry into the economy. The high complexity brings a need for more intensive involvement in research & development and decision making thus increased costs, involvement of the government, and increased bureaucratic procedures.

Instability It is another difficulty experienced by emerging industries considerably. It is the fluctuations in the economic situation of an industry. New and advanced technology emerging industry requires several parties to be involved in. Involvement of various parties leads to increased likelihood of fluctuations in economic conditions. Also, the frequency of entries and leaves by companies being high in emerging industry contributes to instability. High instability affects economic projections and thus profits.

18.5 Discussion and Conclusion

Marketing has a critical role in commercialization process of products and services. It is a more important task for emerging industries than traditional industries due to uncertainty, complexity, and instability which are difficulties faced by the businesses in emerging industries. These difficulties scale up the need for gathering information and accessing information and these are more convenient through digital channels today. With digital marketing, it is much easier to collect information about the factors needed to be known by the businesses to deal with the difficulties of emerging industries such as the specifics and structure of demand, and by the consumers such as expected results. Also, digital marketing provides more information than traditional marketing through digital marketing channels.

It is expressed in various sources that uncertainty has an effect on increasing perceived risk on buyers. One of the methods in reducing the perceived risk is to provide concrete visuals or information about the results or use of products or services. The distribution of video and visual content for products or services through digital media channels will reduce the uncertainty and thus reduce the perceived risk. For example, social media marketing and e-mail marketing tools in Personalize Medicine industry with visual contents will decrease the question in consumers' mind about medical product and services which are recently released.

Emerging industries produce highly personalized products or services. Traditional marketing techniques do not meet the need of personalized products commercialization. Digital marketing tools present personalization opportunity for emerging industries, e-mail marketing in particular, in terms of personalizing marketing approach. Here, personal characteristics come to the forefront. Therefore, industry will benefit from using e-mail marketing for distributing promotional presentations of personalized products and services. Also, they will benefit from social media marketing by directing customer to share their experiences about the products and services they purchased on social media thus ensure that potential buyers have some idea about the products before buying. Hence, this will reduce the questions in their minds and also the uncertainty and risk.

In most cases, digital marketing tools are used in a combination. Influencer marketing is a technique that can be used effectively as a digital marketing tool for experience, eco and personalized medicine industries. For example, influence marketing and social media marketing tools can be used in combination to achieve better results. For instance, share of prosthesis used by an amputee athlete in social media will have an influence on the purchasing decisions of other amputees following him.

Based on our understanding of the digital marketing development and emerging industries' evolvement, it can be said that traditional marketing is limited in comparison to digital marketing which will offer more benefits for emerging industries with its characteristics suitable to emerging industry such as flexibility, easy access, personalization, and so on.

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Chapter 19
Structure and Strategy in Virtual Organizations: Strategies for Virtual Travel Organizations

Nilüfer Vatansever Toylan and Yasin Çakırel

Abstract The new era in the business environment requires the hierarchical structures of the businesses turn into flexible structures, the companies to share the information by combining their competencies and resources. The travel industry must be in cooperation with a large number of actors, as it has to offer a wide variety of products due to its structure. These companies are also in competition because they offer services to similar markets. Buhalis (2000) states that tourism establishes networks to become more competitive compared to other corporate networks. These businesses, which face the "partnership of competitors" dilemma as stated by Hamel (1991), can easily compete in the global business world by adapting to the new structure.

There are many businesses which perform their activities in order to provide services on the basis of a common business understanding. Operating in the same area but having different competencies and resources, accommodation businesses, catering businesses, entertainment businesses and traveling businesses are among businesses that experience the dilemma of competitor partnership in the broadest sense. These businesses blend in their understanding of cooperation with today's technology, achieving the virtual organization structures rather easily. Therefore, this study addresses the network-based strategies of virtual travel organizations, which are in conformity with today's management mentality. In this sense, the concept of virtual organization has been defined in terms of travel sector in particular. After referring to the concept of virtual travel organization, the structure, process and characteristic are discussed. In conclusion, several strategy suggestions have been made for virtual organizations. The literature does not include many studies explaining the strategies on the basis of networks and exhibiting the components that affect the performance of VTO. The study contributes to the literature in

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those aspects and can also be a significant source of information for field students, scholars and professionals.

19.1 Introduction

Organizations have not experienced such a rapid change in any period of business administration history. Huge changes such as globalization of the market, the dissemination of information technology, the birth of the information economy, and the fragmentation of the hierarchy are all happening at the same time. Each change triggers a different change one after another, causing organizations to struggle for survival (Introna & Tiow, 1997). The relationship between the buyer and the seller, which we are used to in the industrial markets to date, (dyad) has gone beyond this pair thanks to the Internet and e-commerce. Network effect goes beyond the bilateral trade (Borders, Johnston, & Rigdon, 2001). Thus, for the emergence of virtual organizations, internet and intranet technologies can be estimated as the most important infrastructure. In the early 1990s, companies started to use network standards and software tools that could integrate different networks and applications across the company into a company-wide infrastructure. As the Internet evolved in a reliable environment of communication after 1995, business companies began to take the Transmission Control Protocol/Internet Protocol (TCP/IP) network standard seriously for linking their different networks (Laudon & Laudon, 2014). The Internet and related e-commerce tools played an important role in the development of the network perspective. One of the most important influences of the Internet on the business has been the blurring of traditional boundaries (Borders et al., 2001). In order to keep up with the change, businesses apply management techniques such as core competence, outsourcing, employee empowerment, downsizing, total quality management, decentralization and reengineering. Each technique has become a powerful metaphor and has been explored and implemented by many managers, academicians and consultants. However, even these are considered as short-term. In this chaotic and bleak environment, the concept of virtual organization has emerged. Encountered for the first time in the book titled "The Virtual Corporation" published by Davidow and Malone in 1992, the concept proposes a new institutional model for restructuring and reviving 21st century enterprises (Introna & Tiow, 1997). It can be observed via the following figure how trade relations between buyers and sellers have changed with e-commerce and networks:

Since the beginning of the 2000s, there has been a trend towards enterprises, e-commerce, virtuality, process management, customer value analysis, cooperation and process management, as exhibited in Table 19.1. The change in the digital age is not limited to individual customer relations. Interactions between companies are undergoing a similar transformation. The relationships limited to bilateral order as "partner or competitor" in the past have become more complicated and intertwined (Rogers, 2016).

Table 19.1 Borders et al., (2001). Beyond the dyad: Electronic commerce and network perspectives in industrial marketing management. Industrial Marketing Management 30, 199–205

Dyadic viewpoint	e-Commerce viewpoint
Dyads	Networks
Legacy systems	e-Commerce
Person-to-person	Virtual interface
Information search process	Intelligence sharing
Negotiation of price	Fixed long-term pricing
Project driven	Process driven
Competitive	Co-opetitive
Firm profitability	Customer value analysis
Transactions and relationships	Enterprise partnering

Davidow and Malone stated that the virtual organization expanded the concepts of time and change in order to respond to the urgent demands of the market. According to them, an organization, Internet and telecommunication is not a guarantee of being a virtual organization (D'Urso et al., 2015). Information systems cannot provide a permanent business advantage on their own. The competitive advantages provided by strategic systems do not last long enough to ensure long-term profitability. As competitors can copy strategic systems, their competitive advantage is not always sustainable. Markets, customer expectations, technology change and globalization have made these changes even faster and unpredictable. The Internet can eliminate competitive advantage very quickly because almost all companies can use this technology (Laudon & Laudon, 2014). Such organizations tend to be agile, flexible and volatile. Therefore, a VO includes people, assets and ideas associated with technology that does not include a physical building. Generally, the virtual employee works from home, remotely and uses the Internet to maintain contact with the company (D'Urso et al., 2015). A virtual team can be defined as a group of people using a variety of communication technologies who interact through field, time, and interdependent tasks, which are guided by common goals across organizational boundaries. Virtual teams are project-oriented; they are created when a project emerges and they dissolve when the project is completed (Ahn, Lee, Cho, & Park, 2005). The concept of organization is defined as "a group of people working together in a structured way for a common purpose". However, when virtual organizations are concerned, being together does not require coexistence by means of space and time (Introna & Tiow, 1997). Virtual teams are groups of geographically and/or organizationally dispersed workers, gathered together using a combination of telecommunications and information technologies to perform an organizational task. The need for organizations to move from traditional to face-to-face teams to virtual teams can be summarized by factors as the increasing prevalence of flat or horizontal organizational structures the emergence of environments that require international organization as well as competition, changes in employees' organizational participation expectations, continuous transition from production to service/information work environments, and increasing globalization of trade and corporate activity. Flat or horizontal organization has emerged in response to the highly competitive business environment due to the recent developments in both information and transportation technologies. Virtual teams can significantly increase the productivity of individual members as they have the potential to significantly reduce the amount of travel requested from their members. Team members will usually work without being in the same environment as their clients or colleagues, and will always need to be prepared for change due to the diversity of tasks. Group success depends on effective communication and information sharing among the members (Townsend, DeMarie, & Hendrickson, 1998).

In the light of these statements, the chapter discusses many interesting and important variables regarding virtual travel organizations, and offers some conceptual virtual organization models for tourism industry. It could be a valuable source of information for students, scholars and professionals in the field. Thus, this study addresses to the characteristics of virtual organizations in general, while aiming to explain in detail the structure and strategies of virtual travel organizations. In this sense, the structure, operation, foundation process and characteristics of virtual travel organizations have been discussed. Furthermore, components that influence the performance of virtual travel organizations have been exhibited, including strategic cooperation, trust, core competence, synergy, communication, information sharing and virtual teams. Finally, some network-based strategies have been presented for virtual travel organizations.

19.2 The Concept of Virtual Travel Organization

Internet technology has made it possible to create value chains composed of highly synchronized industries called value web. A value web is a group of independent companies that use information technology to coordinate value chains to produce a product or service for a collective market, as in the national organization. It is customer-oriented and less linear than the traditional value chain (Laudon & Laudon, 2014). Companies are obliged to create a network value for survival (Borders et al., 2001). Although our subject is not a value chain, it is important to remember that internet technology and its advantages are very important for virtual organizations. All in all, a virtual organization is founded to create value.

In Fig. 19.1 some actors of diverse size and shapes are demonstrated. These sizes and shapes are connected to each other and work together in order to generate several value propositions for the market which is made up of different market sections. Consumers are on the midpoint of this web and they co-create the value of tourism offerings since connections are reciprocal.

Some intermediaries and principals are linked with other intermediaries and principals which shows that the two work together and also compete with one another

An online travel business can be defined as a travel business that receives all of its revenues from online sales. In this respect, it differs from traditional travel companies and airlines. In order to provide an effective service, the online travel business must offer air ticket, hotel and car rental services (Kim, Kim, & Han, 2007). Since

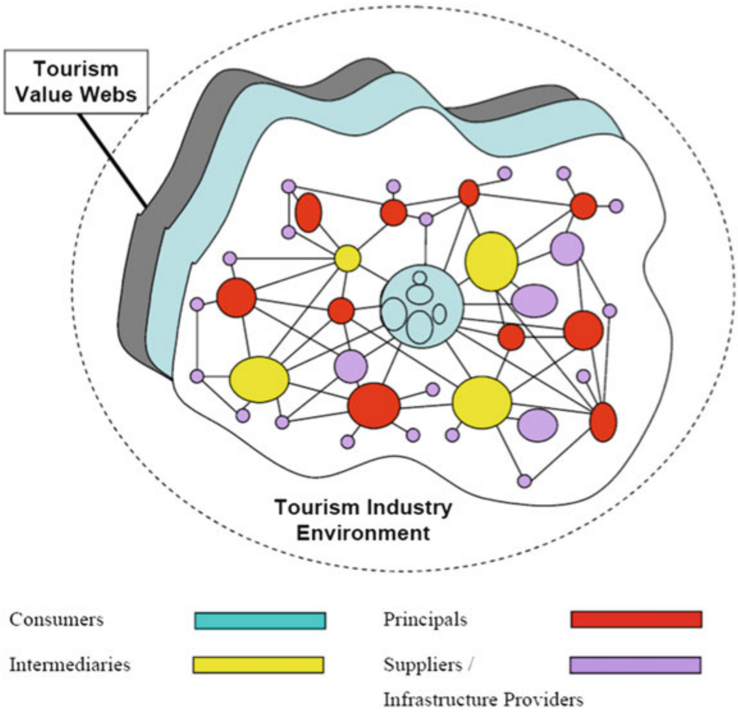

Fig. 19.1 Tourism Industry Environment, Paraskevas (2005). The impact of technological innovation in managing global value chains in the tourism industry. OECD Conference On Global Tourism Growth: A Challenge For Smes, 6–7 September 2005, Gwangju (Korea), p. 11

the concept of virtual organization (VO) can be seen in various versions and each version may have different features, there is no consensus on the definition of VO (Haas, Koeszegi, & Noester, 2007). Oliveira and Rocha (2001) describe the Virtual Organization as a collaboration of legally independent businesses, institutions or individuals. This cooperation provides services on the basis of a common business understanding and appears to be a single company for foreigners. Thus, the difference between the online travel business and the virtual travel business is that the online travel business gets all of its revenues from online sales; while the virtual travel business, in addition to gaining revenues of sales of the products they sell this way, carries out the internal process of the business such as marketing, payment etc., the communication between the employees and with customers, in short, all the activities regarding the business on a virtual environment (online, electronic environment, digital environment).

VO has been classified into four main groups by Mazzeschi (2001):

1. Internal Virtual Organization: The organization's legal boundaries incorporate different business functions or groups of employees work as a VO. However,

since they are physically located at different points they are obliged to work in a flexible manner.
2. Stable Virtual Organization: Such VOs work in the form of outsourcing, by which a focal company develops the VO through certain functions to different entities that are specialized in performing them.
3. Dynamic Virtual Organization: This VO type emerges as a new market or business opportunity, which have a large scale and a temporary nature. The VO may be changed by the members or it may be called off entirely.
4. Web company: Also known as "agile organization", it requires the use of internet in temporary collaboration of different organizations. Knowledge management and knowledge sharing are essential in order for the common goals to be achieved and market offerings to be produced.

In terms of tourism businesses, virtual organizing of tourism business system actors could be defined as a dynamic collaborative network of tourism stakeholders (private and public organizations) which can combine their own capabilities and resources to be proposed as integrated value-added services to satisfy consumer needs in tourism destination (Hopeniene, Railiene, & Kazlauskiene, 2009b). In order to use their scarce resources effectively and efficiently, various studies suggest virtual organizational structures especially for SMEs that can barely compete with large competitors in the market (Frew & Davenport, 2000; Hopeniene et al., 2009b; Matlay & Westhead, 2007).

19.3 Towards Structuring the Research on Virtual Travel Organizations

In the tourism sector, the large number of rival companies require the tour operators and travel agencies to develop new services, improve the services offered and maximize their individual consumer needs and special interests. Therefore, the travel industry must be in cooperation with a large number of actors, as it has to offer a wide variety of products due to its structure. It can be emphasized that the creation and delivery of tourism products are based on partnerships between many organizations such as transportation, accommodation, catering, entertainment and cultural heritage. Thus, companies strengthen their partnership to sustain the market (Hopeniene et al., 2009a).

As a generic phrase frequently used with 'Digital Economy', 'New Economy' or 'Internet Economy' as synonyms, 'e-Economy' mostly depends on digital technologies and communication networks that provide a global platform where individuals/firms can interact, communicate, collaborate, and sell/purchase a vast portfolio of products and services (Turban, King, Lee, & Viehland, 2002). The increasing impact of information and communication technologies (ICT) and global competition requires understanding of the complexity of interaction with multiple stakeholders across the global tourism supply and distribution chain (Walker, Greiner, McDonald, & Lyne, 1998). Afsarmanesh and Camarinha-Matos (2000), Braun (2005) state that the twenty-first century welcomes the virtual organization as the dominating form of business system. Therefore, networking is empowered through ICTs across the industry and the interactivity between tourism production and distribution partners is improved in a way that supports a closer cooperation towards the procurement of diverse products. Additionally, in order to achieve economies of scope, organizations will need their product constantly adapted to satisfy tourism demand, use information extensively, develop partnerships; and outsource a significant amount of functions (Buhalis & O'Connor, 2005).

Thus, it is stated that a virtual organization should include features such as cooperation, network structure, gathering basic skills, removing borders, sharing risks, sharing information and technology, trust-based relations and effective communication as the background of today's dynamic environment (Introna & Tiow, 1997).

19.4 Structure of Virtual Travel Organizations

Immediately before the rapid development of internet technologies, intermediaries used Computerized Reservation Systems (CRS) technologies very effectively to increase and strengthen their position in the value chain. First Airline CRSs were developed as proprietary online services in the mid-1980s in Global Distribution Systems (GDS), for example, offering paid access to the Travelshopper from PARS (eventually becoming Worldspan). Then, by switching to companies such as EasySABRE, WizCom and THISCO, technologically advanced agents provided GDS links to their CRS (Paraskevas, 2005).

The tourism operating system at regional or national level is the link between state tourism organizations, regional tourism organizations and local council and tourism operators. Susnienė and Vanagas (2007) argue that it is very important to consider the interest harmonization and satisfying stakeholders' expectations and needs in order to ensure the successful collaboration among tourism business system stakeholders, since people and organizations tend to retain relationships when the latter correspond to their interests. The actors of a tourism business system with the potential for virtual organization can quickly and easily create functional and technologically diversified but interdependent tourism organizations and adapt to changing conditions, providing good intuitive approaches to confronting the challenges of turbulent markets. Establishment of any collaborative coalitions depends on actors who share several common objectives, having a certain amount of mutual trust and having created common (able to exchange and utilize information in computer systems) IT infrastructure and agreed on several common commercial applications and values (Hopeniene, Railiene, & Kazlauskiene, 2009a). According to Afsarmanesh and Camarinha-Matos (2005), achieving these conditions is a prerequisite for agility and combinability in a virtual business system as a collaborative network. Thus, it can provide access to cooperation, innovation, new markets and technologies of the actors of the tourism business system and connect different competencies to a consistent product.

The structural changes have caused new varieties to enter the sector. Network structures began to form in the travel and tourism industry. Orbitz.com was created by airlines in the US and now offers full travel services in the same way as Opodo.com in Europe. Travelweb.com was re-launched as a partner of five major hotel chains. In addition, travel comparison websites emerged as a new variety, providing customers with a price and feature comparison of travel products (Paraskevas, 2005).

19.4.1 Establishment Process of Virtual Travel Organizations

While travel businesses apply to ICT to support Interactions and collaborations, the alliance of tourism organizations creates a virtual enterprise (VE) and enters into the paradigm of new smart organizations. This makes a virtual smart organization for tourism a temporary consortium of different organizations which represents service providers including traveling agencies, accommodation providers, organizers of leisure programs, or public tourism organizations. With the purpose of offering an integrated and aggregated service or answering to a business opportunity in a better manner, these organizations join their skills and resources and this cooperation is supported by the computer networks.

There are a number of approaches to the transition process of traditional travel businesses to the electronic business. The first one is to establish a partnership with the technology provider. This approach applies to travel companies that have no experience in the electronic environment. The second is the portfolio partnership. According to this approach, the technology provider may not be suitable for the needs of the travel business and therefore, the appropriate partner should be selected. The third approach is the travel business investing in terms of developing its own electronic commerce technology (Cheung & Lam, 2009). Wang and Cheung (2004) outline the three factors that have an effect on the adaptation process of a travel business. These are environmental factors, organizational factors and managerial factors. Environmental factors are defined as institutional pressure and competitive pressure. Organizational factors are defined as adaptation to innovation, financial problems, internet technology resources and perceived advantages of electronic business. Managerial factors are defined as the risk-taking tendency of the CEO.

19.4.2 Characteristics of Virtual Travel Organizations

It is often difficult to separate cooperation from competition in a tourism industry because both try to make the most of public and private resources, protect the environment and improve human resources, and disseminate information to

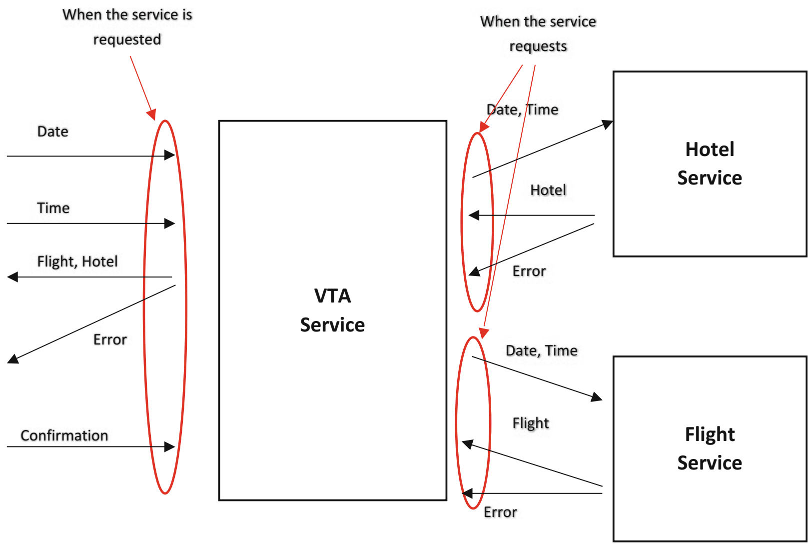

Fig. 19.2 Block Diagram of Virtual Travel Agency, Ringe, Nandini, Sharma, and Rege (2013). Semantic Web Enabled Virtual Travel Agency. *International Journal of Scientific & Engineering Research*, *4*(6), 2995

consumers. The relationships with various tourism stakeholders, diffusion of the system of information technologies which travel services are supplied with result in a new business system's organizational form and this is called a virtual organization (Bagdoniene & Hopeniene, 2006).

The most important features of virtual travel businesses are, as seen in other virtual businesses, cooperation, trust, core competence and the need to make the organizational structure suitable and ensure non-hierarchical coordination. As suggested in a study (Long & Shi, 2017) that examines the relationships between Tour operators and the Online Travel Agency; the O2O model, as a new e-commerce business model that combines both online trading and offline experience, has become an important strategy for the development of businesses in recent years. The main characteristic of the tourism products is the simultaneous realization of production and consumption, and the cooperation between OTAs and hotels or airlines is rapidly developing the tourism O2O model. On the other hand, as shown in Fig. 19.2, End-User services to search and book hotel and flight tickets are provided by a web service of a virtual travel organization called VTO/ VTA in short. The web-service is made up of other web services such as accommodation and transportation services. The VTO registers these services which are generated and published by different companies.

Nonetheless, alliances among the virtual organizations are defined as a network organization of independent enterprises (organizations, groups, individuals) which cooperate to discover a business and/or market opportunity. Such inter-organizational arrangements are often due to the convergence of two tendencies:

first, technological advances that radically change communication between companies by establishing links for value-shared knowledge, and secondly, by increasing the importance of knowledge and innovation for networked organizations. The business motivation for such arrangements incorporates the potential for increased value added and competitive advantage from the enhanced knowledge stock and core competencies and they are considered to accrue to such networks (Panteli & Sockalingam, 2005).

19.5 Components for a Conceptual Model of Virtual Travel Organizations

In terms of system theory, we can show the virtual organization as a purposeful system consisting of a number of related elements (Ackoff, 1971). The authors regard the virtual organization as a kind of cooperation (network, alliance) between organizations, companies, groups or individuals. Other authors define the network as a combination of core competencies or activities (Goldman, Nagel, & Preiss 1995). For travel businesses, it is common to work with cooperation or network structure due to the fact that the touristic product is created with the combination of many products (bundling product/service bundling). However, the most important difference here is to include ICTs in processes and to work in harmony with the ICTs. In this process, a dynamic holiday package will emerge, which can be defined as a combination of different travel components packaged and priced in real-time in response to the demands of consumers and agencies (Cardoso, 2005). Therefore, it can be said that the most suitable model for travel companies is cooperative network enterprises.

Virtual organization is becoming a strategic characteristic which can be implemented to any organization without being constrained physically, geographically or structurally. Network is the backbone of VOs. In order to enable efficient collaboration in VOs and take care of VO activities, breeding environments are used for a long-term supporting network (Nami, 2008). In this collaborative network structure, information systems may incentivize the synergy, cooperation, fundamental skill (Laudon & Laudon, 2014), communication, information sharing and trust, thereby increasing performance (Hopeniene et al., 2009a).

19.5.1 Virtual Hospitality Teams

The groups of employees with unique skills, situated in remote locations, the members of which are obliged to collaborate using technology across space and time to accomplish important organizational tasks, are defined as virtual teams. Using technology for communication and collaboration, virtual teams consist of people working interdependently with a purpose shared across space, time and organization boundaries. There are many studies on virtual teams. Some of these try to determine the importance of face-to-face interaction on performance, while others consider cooperation important (Kirkman, Rosen, Tesluk, & Gibson, 2004).

Ahn et al., (2005) gathered the characteristics of virtual teams under three headings. The first is that virtual organizations are project-based organizations. The teams are focused on the task in the project. As they are project-based, they do not have a long-standing common history and come together in temporary teams. The second feature is that they are a distributed and heterogeneous team. Therefore, they are not physically in the same region. Their organizational backgrounds and cultures are variable. They are opposed to space and time constraints, organizational barriers, and they are composed of special individuals who come together functionally. The third characteristic is that they are non-routine and they carry out knowledge-intensive tasks. They undertake new, non-routine and independent tasks.

The main function of the travel agency is to provide tourism products that make sales to customers on behalf of suppliers such as airlines or hotels. Old bulk holiday packages are no longer attractive for “new’ tourists, and therefore, a change in business strategy needs to be made for a more individual approach. However, so far, the main advantages are that they can collect data based on the needs of unique customers and offer much more customized and specific information to the customer (Kim et al., 2007). In addition, traditional travel agencies often provide a personal human relationship that increases confidence and security. Nevertheless, they are said to prefer the rather well-known service providers who can demand fairly high prices. It is also reported that travel agencies working offline have the control of information that limits their transparency and leads to the opportunity to receive redundancy from consumers (Henne, 2014).

Similar to traditional travel agencies, they act as an intermediary between travel-related products, information and customers (Kim et al., 2007). However, OTAs only work online and do not take part in any offline channel to reach their target customers. They offer the online buyer the possibility of combining their own customized holidays by selecting an individual flight, hotel or potential car rental. However, based on the wide range of options, people can become astonished and lose their perspective. Therefore, OTAs need to identify customers’ expectations and requests in detail to ensure high quality of service and often reduce the degree of uncertainty associated with online transactions (Henne, 2014). However, the most important problems of such enterprises are information leakage and security. However, the fact that the parties who do not communicate face to face trust each other is also seen as an important problem. Nevertheless, there is a large customer base that is keeping up with the changing era.

19.5.2 Synergies

The idea of synergy is based on the understanding that the output of some units can be used as input to other units or that enterprises can use their common markets and expertise together. Thus, a common value can be created. In terms of virtual travel enterprises, value co-creation should be a process of a whole rather than the sum of distinct, individual value creating efforts. Thinking as a whole rather than in parts should be the way the actors of the web think. Consumers want a 'vacation', not "flight + 7 room nights + food + drink + recreational activities (Paraskevas, 2005). Tying together the operations of disparate business units so that they can act as a whole is one use of information technology in these synergy situations (Laudon & Laudon, 2014).

19.5.3 Core Competences

It has become a must for enterprises that have been digitalized to undergo a structural change in the organizational dimension. Organizational structure should be compatible with information technologies and this should be compatible with organizational culture. Businesses need to become more horizontal and focus on their basic skills and to outsource their work to external sources (Aksel, Arslan, Kızıl, Okur, & Şeker, 2013).

The value creation process should be pursued by making use of the key competences of the actors involved in the Collaborative Network and avoiding the repetition of efforts. The rules that determine the value creation processes require the operational design, technology and organization to be aligned in a certain order throughout the value network (Paraskevas, 2005). Increasing the performance of all business units depends on the development of central core competencies of these business units. A core competence is an activity where a firm is a world-class leader. In general, a core competence is based on knowledge gained from a long-standing practical field experience with a technology. This practical knowledge is typically supported by a long-term research effort and affiliated employees. Competence is enhanced across business units via any information system that encourages knowledge sharing. Available competencies may be encouraged or enhanced by such systems, which may help employees realize this new external knowledge and also help a business utilize available competencies with respect to related markets (Laudon & Laudon, 2014).

In order to fulfill business opportunities, when additional skills/resources are required, companies within the tourism industry keep their focus on core competencies and realize the requirement to seek alliances (Afsarmanesh & Camarinha-Matos, 2000). Therefore, core competencies are an important element for businesses to create virtual network structures, especially with ICTs.

19.5.4 Strategic Cooperation

The strategic alliance or partnership is the key attribute of a virtual organization for most authors. It is a tactic commonly used by companies to provide access to new markets or technologies and to provide the flexibility needed to overcome market barriers to reach new products. Strategic alliances can be dispersed when they achieve their goals and continue to build partnerships with new people or companies. As it is understood from this point of view, the alliances in virtual organizations are based on flexibility, agility, change and opportunism exist (Introna & Tiow, 1997).

Cooperation among the entities in Tourism industry is not a new phenomenon. For example, aggregated or value-added services consisting of components supplied by a number of different organizations are offered by travel agencies in general. However, a networked cooperation must exist among many different organizations in order to provide value-added service for "booking a complete journey plan" that may include several means of traveling, several hotel bookings, car rentals, leisure tour bookings, etc., (Afsarmanesh & Camarinha-Matos, 2000; https://ieeexplore.ieee.org).

In addition, becoming part of a value web is not just about creating a strategic alliance. This requires a major cultural shift to incentivize trust between all the actors and an understanding that all components of the web are equally important in order to co-create a set of 'winning' value propositions for the consumer. It also makes it mandatory for actors to stop trying to expose their partners to business risks while keeping the rewards for themselves and to discard their 'win-lose' mentalities. Cooperation from all the actors in the web (including the consumer) is required for consumer-centricity at all stages of consumer experience (Paraskevas, 2005).

19.5.5 Communication and Knowledge Sharing

Strategic information systems often change organizations' products, services, and operating procedures and direct the organization to new patterns of behavior. Successful use of information systems to achieve competitive advantage is difficult and requires precise coordination of technology, organizations and management (Laudon & Laudon, 2014). Group success depends on effective communication and information sharing among the members (Townsend et al., 1998). However, the fact that communication in virtual environments has some difficulties should not be ignored. First, since virtual teams are often organized for temporary targets, contextual information can be easily lost between dynamic changes. Second, virtual teams consist of distributed groups of people, where communication is mainly restricted by Internet-based methods compared to face-to-face collaboration, which can create problems for the accumulation of contextual information. Third, the tasks of virtual teams are often not routine and knowledge intensive, which requires a high level of understanding with contextual knowledge (Ahn et al., 2005).

Online channels play a very important role in the service and hospitality industry. According to Wu, Law and Jiang (2013), one-third of travelers going to Hong Kong are looking for hotel information online, and about 50% of them book rooms through the websites they receive information. In such cooperation, some features should be carefully supported. Typically, these organizations use heterogeneous inheritance systems as internal information systems with their own cultures and special human skills, and use specific data models and different computing platforms. Moreover, businesses are autonomous nodes in the network. They are mostly developed and work independently from each other, and may even be competitors, except for the common purpose of virtual enterprise. Depending on many internal and environmental factors in terms of their technological infrastructure, they can develop in different ways, not only in technological quality but also in their own internal behavior and rules. (Afsarmanesh & Camarinha-Matos, 2000; https://ieeexplore.ieee.org). For example, Alzon (2000) states that Degriftour is not only a virtual travel business, but also has the task of providing accurate and up-to-date information to its customers, and that this makes great investments in information systems.

19.5.6 Trust

In an environment where someone interacts with others in an electronic environment, it is natural to expect the participants to wonder if the system is being used to monitor and evaluate them. The free flow of communication, which may have occurred once while team members were away from the office, may now be prevented with concerns regarding privacy and system security. To address this issue, organizations should establish a clear policy of communication confidentiality and then strictly adhere to this policy. Over time, participants will realize that the virtual team system is a safe environment for sharing ideas and concerns (Townsend et al., 1998).

In virtual organizations (VO), trust among people, or trust of people in the company is an important issue, as well as the trust of companies in other companies or in the businesses they cooperate with. Businesses that use cloud technologies for the services they provide need to trust on the organizations from which they receive services or the customers need to trust on the storage resources of these companies. Using cloud computing, virtual teams can cooperate on a large scale. The structure of the VOs allows this flexibility and eliminates cloud computing connectivity limitations (D'Urso et al., 2015). However, cloud computing has some disadvantages. Unless the users decide to store their data locally, the data retention and control responsibility is in the hands of the provider. Some companies are concerned about security risks associated with entrusting critical data and systems with an external vendor working with other companies. Companies expect their systems to be accessible 24/7, and if the cloud infrastructure fails, they don't want to lose their ability to work. Another limitation of cloud computing is that users become dependent on the cloud provider and this may not be desirable. However, the trend is that companies shift their computing operations and warehouses to more cloud infrastructure (Laudon & Laudon, 2014).

As stated by Kirkman, Rosen, Gibson, Tesluk, and McPherson (2002), most of the consultants and researchers are in agreement that building trust is the most difficult challenge for creating successful virtual teams and organizations. Trust has been regarded as the element that holds the global workplace together. The network does not have any hierarchies, or it has a very flat transient hierarchy that focuses only on functionality across the value chain. Collaboration is based on trust and on the purpose of contributing to what each company considers as their core competencies (Keinanen & Oinas-Kukkonen, 2001). Therefore, IBT has the biggest potential for effective, value-adding knowledge sharing. Significant levels of valuable tacit knowledge and diverse sets of knowledge is shared and understood easier via the common ground as the sharing of more classified knowledge to enhance the potential of creating new knowledge, which is critical for competitive advantage, can be enabled via the trust built over time (Panteli & Sockalingam, 2005). Therefore, trust may increase or decrease the employees' belief in each other, the enterprise or other businesses depending on the established communication behavior. It is known that a large number of enterprises come together to create a common value in the travel platforms created with a collaborative virtual network. A cluster represents a long-term organization; thus, when building new business models, an adequate environment to establish cooperation agreements, common infrastructures and ontologies and mutual trust become the facilitating elements (Camarinha-Matos & Afsarmanesh, 2001).

19.6 Network Based Strategies for Virtual Travel Organizations

Today, collaboration networks are seen as virtual factory, virtual company, entrepreneur networks, expanded and dynamic clusters and also other organizational forms. All new forms of organizational business systems are possible because information and communication technologies are capable of changing the traditional time-space interaction (Hopeniene et al., 2009a).

Some of these are strategic models for destinations, while others are directly related to tourism businesses. Thus, tourism networks are complex and entities, which change and evolve constantly over time in correspondence to environmental and organizational developments and demands (March & Wilkinson, 2009). In this section, we present two models which are discussed in the literature the most and which we will approach in terms of travel companies. One of them is virtual enterprise or virtual company model and the other is the virtual community model which is also seen as part of tourism business ecosystem.

19.6.1 Virtual Company Model

One of the network-based strategies is the virtual company model established to create a competitive business. The virtual company, often known as virtual enterprise in the literature, uses networks to connect people, assets and ideas, and collaborates with other companies to create and distribute products and services without being limited to traditional organizational boundaries or physical locations. A company can use the capabilities of another company physically without being connected to that company. The virtual business model is useful when a company finds it cheaper to acquire products, services or talent from an external vendor, or when it needs to act quickly to take advantage of new market opportunities and lacks time and resources to respond on its own (Laudon & Laudon, 2014).

A virtual business is defined as a temporary alliance that collaborates to share skills or core competencies and resources to better respond to business opportunities, and whose collaborations are supported by computer networks (Camarinha-Matos & Afsarmanesh, 2001). Due to their competitive and fast market response in a saturated business environment, VEs possess a good advantage. It is intended that VE establishes a dynamic organization via the synergetic combination of dissimilar companies with different core competencies, forming consortium that includes the best of everything to perform a specific business project in order to achieve maximum customer satisfaction. VE is a temporary consortium consisting of partners from different organizations established in order to realize a task that adds value, i.e. fulfilling a product or service demand of a customer (Sari, Sen, & Kilic, 2008).

The "DIY" scenario of tourism business can be affected significantly by the Internet. Individuals and companies that seek information about destinations, accommodation, transportation, etc., and trying to take advantage of the best opportunities tend to combine different tourist products and configure their own arrangements. Furthermore, tourism organizations require a broad range or local or even international services including restaurants, entertainment, leisure, etc. in order to respond to the requirements of their customers. Thus, they are provided with the choice to either enter an alliance or develop a tourism business network, providing overall information and offering integrated products and services (Stiakakis & Georgiadis, 2011).

19.6.2 Virtual Communities in Business Ecosystem Model

A business ecosystem concept is based on the idea of gaining value through the web; the main difference is that cooperation takes place in many industries rather than many companies. For example, both Microsoft and Walmart offer platforms of information systems, technologies and services that thousands of companies in different industries use to develop their capabilities. Information technology plays a strong role in the establishment of business ecosystems. Obviously, many companies use their IT systems to turn into key firms by building IT-based platforms that other companies can use. During the digital company period, we may expect to put more emphasis on the use of IT to build ecosystems of the sector, as the costs of joining these ecosystems will decrease and the benefits for all companies will increase rapidly as the platform grows (Laudon & Laudon, 2014). Increasingly, organizations often develop professional communities to rely on a large pool of expertise, or to enable participants to help each other when problems arise and to transfer information. Such communities can be perceived as digital ecosystems where individuals with different levels of interest and resources participate and where resources are provided in a benefit-giving way for everyone (Wagner, Liu, Schneider, Prasarnphanich, & Chen, 2009). One of the important business ecosystem trends is overlapping with consumer-oriented online communities. Today, the fastest growing online community is Facebook. Although originally intended for consumers, it is now used by companies. It is therefore important to consider creating new business networks on consumer networks. Porter (2004) defines virtual communities as an aggregation of individuals or business partners interacting around a shared interest, where the interaction is partially supported as a minimum and/or mediated by technology and guided by some protocols or norms. For example, nowadays it is one of the fastest growing types of shopping to buy products on the internet. Both web-based and traditional travel companies have started creating their own online virtual community websites to attract potential customers to their home pages. People can connect with virtual communities on company home pages to interact with other people with similar interests (Kim, Stephen and Hiemstra, 2004).

As 2000s turn to 2010s, social media has asserted its dominance in the industry and the traditional one-way communication from supplier to consumer has been dramatically converted to an open communication from consumer to consumer by travel community sites such as TripAdvisor. The way the consumers collaborated and shared information which information has been changed by the word-of-mouth revolution (Thakran & Verma, 2013). In a study conducted in the DIALOGOI virtual community of the Association of Greek Tourism Enterprises, Chalkiti and Sigala (2008) determined that virtual enterprises supported information sharing and generating ideas, and that they were able to communicate in an asynchronous manner to the geographically dispersed members working in different sectors, thus initiating a social network and obtaining available information that was transformed into knowledge when they were implemented in a business context. As can be observed, virtual communities have a multifaceted effect in the tourism sector. Because, it can affect consumers, producers, intermediaries and various businesses in the ecosystem and creates an interactive environment that enables them to interact with each other.

19.7 Conclusion

Today, with the rapidly developing technology, business structures are also subject to rapid changes. In this case, enterprises are expected to move away from traditional concepts and structures and adapt to new concepts quickly. Change is one of the most important keywords in virtual organizations. A network organization must have the ability to be created, processed and terminated in a timely manner. Therefore, this section aims to give information about the dynamic mechanisms of virtual organizations. In this context, as one of the important actors in the tourism industry, since the travel organizations have a dynamic structure and they can adapt quickly to virtual organizations and networks, they form the area of research for this study.

In the tourism sector, the consumer's emotional participation has a significant impact on organizational performance in terms of value, customer attitude and loyalty. The on-line is assumed to encourage the exchange of information and transaction networks between members of different communities. Since the pressing of the Internet button in 1989, people from all over the world have begun to communicate and work with each other. In fact, face-to-face communication establishes relationships of trust by creating better connectivity, collaboration and business opportunities. Therefore, complementary elements in which information sharing and synergy take place are important for the tourism and travel industry, where trust, cooperation, and the basic capabilities of employees and businesses are used in virtual structures.

It is difficult to have all the skills and resources needed to gain and sustain a competitive advantage. The successful partnership and cooperation of tourism business system actors strengthen the competitive advantage of tourism organizations. In order to create a tourism product that meets the needs of a customer, the integration of tourism enterprises into a business system and the business relations that realize this are required.

In order to meet the specific needs and interests of tourists, tourism business system actors organizing their activities virtually are engaged in the joint production of a service product and competence. Integration into the business system allows companies to find a balance between cooperation and competition, reducing competitive uncertainty without hampering incentives to renew and invest in common tourist assets. Some of the key features of the virtual organization are the concentration of core competencies, strong customer focus, creation of value-added products and temporary, dynamic networks of independent companies based on information and communication technology (Hopeniene et al., 2009a).

Therefore, the strategic elements appropriate to the virtual organizational structure have been introduced with the anticipated complementary elements owned by the virtual travel companies. This way, the reason for the complex structures they have in the virtual organization structure of the travel companies can be better understood. In addition, travel companies will be able to maintain their competitive advantage by using these models.

In summary, these strategic models proposed for travel businesses can help the Travel Businesses, consisting of more than one business unit, to provide additional efficiency of information systems or to develop various services by linking the activities of different business units. Information systems help businesses increase the core competencies of businesses by promoting the sharing of knowledge among business units. They facilitate business models based on large user networks or subscribers who benefit from the network economy. A virtual company strategy, using networks to connect with other companies, creates the products and services of other companies and uses their marketing and deployment capabilities. In business ecosystems, multiple industries work together to value customers. As shown in the various explanations and examples above, information systems support an intense network of interaction among participating companies.

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Part IV
Accounting Applications in Blockchain Ecosystem

Chapter 20
The Doors Are Opening for the New Pedigree: A Futuristic View for the Effects of Blockchain Technology on Accounting Applications

Soner Gökten and Burak Özdoğan

Abstract Developments in communication technologies have enabled entities to benefit from new technological infrastructures with improved efficiency. In this context, blockchain, as a new, innovative communication technology, can provide a better solution that promises efficiency and improved transparency for every kind of transaction that involves value exchange including stocks, derivatives, interbank transactions, and accounting operations of entities. Today, whenever a value exchange transaction is needed between individuals or institutions, a regulatory and intermediary body is needed in order to ensure trustworthiness and transparency. Supporters of a blockchain called the "internet of values" argue that it sustains a more reliable infrastructure without any intermediary, unlike traditional systems that include regulators and intermediaries. Blockchains established by private institutions for intercompany operations give the decision-making authority of record approvals and monitoring ledgers to the system's managers. Especially companies or institutions can benefit from these private blockchains without a need for a trust mechanism such as intermediaries. This chapter aims to exhibit the current accounting operation areas that blockchain technology impacts, s as well as the future direction of the integration between the technology and accounting.

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20.1 Introduction

Accounting has gradually evolved over centuries to better process information in speed, form, and content in tandem with professionals' needs. Industrial revolution, mass production, internationalization, and modern business structure together have accelerated the data production processes and strengthened the data-value relationship of enterprises. Nowadays, data flow from dozens of sources can be managed and transformed into meaningful information to support decision-making processes. However, in the beginning, it was seen as an important competitive advantage and a necessary infrastructure tool for enterprises to ensure sustainability. In this process, accounting has continuously improved and enriched its toolbox as an information system in order to meet the expectations of internal and external stakeholders. It aims to respond to the information needs of external stakeholders through areas such as reporting and auditing, while on the other hand supporting business decision-making processes through systems such as ERP (enterprise resource planning) (Özdoğan, 2017). As a key element of reliability and transparency throughout the process, regulatory authorities issued many acts and standards both in accounting and auditing and tried to address the deficiencies of the system. However, despite all efforts, significant disruptions in the system, scandals, and fraudulent operations that led to crises could not be prevented. The reasons included a weak corporate governance structure, a lack of internal control, audit inefficiencies, and ethical issues (Greiling & Spraul, 2010; Soltani, 2014). As such, it poses a formidable challenge for executives, external stakeholders, and regulatory authorities to create information as well as ensure the reliability and transparency of various sources of information.

Rapidly evolving communication technologies have made the data one of the most important assets for businesses; therefore, the need to secure the data has become an important subject. The major challenges between companies are to become a data-driven company and create a competitive advantage. While the big data created by companies is growing exponentially, data security is particularly vital to businesses in terms of accounting information (Borthick & Pennington, 2017). The accounting information system, where all commercial operations of businesses are recorded, should meet corporate privacy requirements. However, the need for a system that ensures data security as well as data efficiency, accuracy, and reliability remain an unsolved issue. Blockchain technology is a solution for the accounting profession that combines the transparency, reliability, and accuracy elements sought within the regulatory environment affecting the existing technologies of enterprises, accounting standards, and international regulations (McCallig, Robb, & Rohde, 2019). Blockchain technology, first mentioned and propounded by Nakamoto in his paper on cryptocurrency Bitcoin (Nakamoto, 2008), has been rapidly developed, and it has been claimed to offer a potential platform for leading business practices. With the help of its distributed ledger infrastructure, Blockchain technology is committed to introducing the high-level reliability, traceability and transparency features of enterprises' data processing and monitoring processes.

This chapter examines the current and future reflections of blockchain technology in accounting practices. The chapter is designed as follows. The transformation of accounting from primitive applications to an information system is covered in the following section. In the third section, the digitalization needs of accounting profession in terms of changing information demand of businesses is discussed. Finally, the effect of blockchain technology on accounting practices and accounting information systems is discussed from a futuristic perspective.

20.2 Primitive and Post-Pacioli Accounting

Data usage in operations and decision-making is a common desire of all parties involved in commercial transactions. Accounting records are the most practical tools for achieving this common goal, regardless of how they were journalized and continually improved.

Even before Pacioli's Summa de Aritmetica was written, primitive accounting records were kept. However, during this period, there were serious reliability and accuracy concerns for accounting results since the entries could not be closed and business activities could not be transparently identified. Therefore, it was a time when the significant risks of error and fraud occurred (Lauwers & Willekens, 1994). When Pacioli wrote Summa de Aritmetica approximately 500 years ago, he presented the double-entry recording system, and the disadvantages of the primitive accounting system were eliminated, the accuracy of the records was consolidated, and the data-driven decision-making and management improved considerably (Lee, Bishop, & Parker, 2014). With the double-entry bookkeeping system, the data produced in the enterprise began to be presented in a more meaningful manner, and the reliability and transparency of the records were improved (Sangster, 2015).

No significant changes were observed in the accounting records until the nineteenth century. After the industrial revolution and accompanying modern production techniques, there was a separation of the ownership and management structures of the enterprises, the transformation of the data needs of the enterprises, and accounting gaining rapid momentum and evolving into an information system (Fleischman & Tyson, 1993; Lauwers & Willekens, 1994; Anandarajan, Srinivasan, & Anandarajan, 2004; Gökten, 2018). In particular, the separation of ownership and management structure of companies and the emerging problems (agency problems, fraudulent operations), around them increased the need for reliability and transparency of accounting data. Thus, demands for independent evaluation of the reliability of accounting reports produced within the enterprise emerged (Chow, 1982; Wallace, 1980).

20.3 Accounting in the Era of Digitalization, Precautions for Reliable Information and Non-Preventable Causes

Since the beginning of the 2000s, ERP, enterprise information systems software (EIS), and integrated accounting information systems have been used extensively to enable the use of massive amounts of data generated in complex business structures to be used in business management and to make decision-making processes more efficient (Ghasemi, Shafeiepour, Aslani, & Barvayeh, 2011; Mancini, Dameri, & Bonollo, 2016). When using ERP systems in enterprises, the role and responsibilities of accounting functions are differentiated and expectations related to function increase (Chen, Yan Huang, Chiu, & Pai, 2012; Newman & Westrup, 2005). By using ERP, the data collection tasks of the accounting unit decrease, decision support tasks increase, and reporting skills improve (Brazel & Dang, 2008; Caglio, 2003). While ERP systems strengthen the role of accounting, in addition to the professional competencies of accountants, new competencies such as better usage of complex software, stronger communication, and decision making are acquired (Grabski, Leech, & Sangster, 2008; Jean-Baptiste, 2009). As a result of a successful ERP application, errors in data entry and unnecessary records can be eliminated since many activities are simplified, a reduction of up to two-thirds in accounting personnel may occur (Markus & Tanis, 2000). As a result of the developments in communication technologies, access to costs of technologies such as big data analysis and cloud computing has decreased significantly, and thanks to the start-ups, which have entered the market in succession, the access of enterprises to these technologies has increased. After this development, which we can define as the democratization of benefiting from data, ERP and similar technologies are become reachable not only for big corporations but small companies as well.

Technological infrastructures, which allow enterprises to obtain meaningful results from the data they produce, are developing gradually. On the other hand, problems persist in the process of accessing accurate, reliable, and transparent information to shareholders. The history of accounting-based fraud, corruption, and scandals dates back as long as accounting history, and in every transformation of the accounting profession, different measures are taken; however, each measure is insufficient (Briloff, 2001). In particular, as a result of the international company scandals in the early 2000s, regulatory authorities and professional organizations around the world have taken important steps to prevent enterprises from preparing fraudulent financial reports as a result of fraudulent accounting operations (Dewing & Russell, 2004; Fearnley & Beattie, 2004). After the scandals, the accounting policies followed by the enterprises and the records they kept (Brewster, 2003), the independent audit process that approved the financial reports prepared by the enterprises (Hatherly, 2003; Reinstein & McMillan, 2004), and the legal regulations (Karan, 2004; Unerman & O'Dwyer, 2004) started to be questioned.

Sarbanes Oxley and similar legislation issued in the following period, as well as regulations such as International Auditing Standards and International Financial Reporting Standards, which are rapidly recognized worldwide, have important objectives such as prevention of similar scandals, transparency of financial reports, and timeliness of information.

On the other hand, in order to maximize the efficiency of in-house accounting information, enterprises allocate significant resources to digital technologies and have decision-based decision processes by means of ERP software. However, despite all the interventions and investments carried out by both the enterprises and the regulatory authorities, it is not possible to ensure that the shareholders and enterprises themselves have access to accurate, timely, and reliable data and are able to prevent fraud and corruption. The reliability of the independent audit mechanism, which is established to provide transparency and assurance to the system, has become questionable even after various scandals (Cunnigham, 2006; Ronen, 2010; Roy & Saha, 2018). The complex related party transactions and other accounting operations, especially applied by large companies, make the auditors work hard and make the detection of illegal schemes difficult (Hung & Cheng, 2018).

20.4 Blockchain Technology as an Infrastructure of Value Exchange

After being introduced as a cryptocurrency infrastructure by Satoshi Nakamoto in 2008, Blockchain technology is seen as a promising infrastructure for financial operations, supply chain management, and all business operations that require a transfer of value. Thanks to the infrastructure consisting of distributed ledgers, records are digitally created with the approval of the related parties, time-stamped, cannot be changed and the whole transaction history can be displayed (Nakamoto, 2008). Blockchain technology offers three different usage options in general: public and private or hybrid. While all of the transactions recorded in the public Blockchain can be monitored without any approval or authorization mechanism, transactions are performed by the parties previously authorized in the private Blockchain and these transactions can be monitored by other authorized parties (de Kruijff & Weigand, 2017). One of the most important capabilities of Blockchain infrastructure is that the process reliability can be achieved without any intermediary when an operation is performed on the system. In this way, even the parties who do not know each other can make a reliable and transparent transaction thanks to the infrastructure (Nofer, Gomber, Hinz, & Schiereck, 2017). Private blockchain offers the privacy and limited access opportunities required by the enterprises and pave the way for the use of blockchain infrastructure in business operations (Pilkington, 2016). With private blockchain, a group of companies can create their own encrypted network and keep the data accessible by only within the group members while having the advantages of blockchain (Morkunas, Paschen, & Boon, 2019).

One of the technological infrastructures developed within the Blockchain ecosystem is smart contracts. Smart contracts; is an infrastructure that allows the exchange of digital or physical assets within the framework of pre-determined conditions, rules or allows certain transactions to be realized (Buterin, 2014). Although the conceptual framework was previously drawn by Nick Szabo in 1994, its transition to implementation has been associated with blockchain technology (Szabo, 1994). Smart contracts automatically perform the transaction specified in the contract and record them in the blockchain without any intervention or control when the transaction conditions are fulfilled (Christidis & Devetsikiotis, 2016). The rising interest in the technology was initially on cryptocurrencies and the extreme volatility in the market value of those, but in a short period, it was clear that the doors of an agentless, reliable and transparent process for the exchange of any form of "value" were opened. Shortly the potential applications in many sectors, especially finance, have begun to be discussed while accounting also took place at the forefront among these areas.

20.5 A New Pedigree for Accounting and Discussions on Possible Future Directions

As for many other business activities, Blockchain technology is an infrastructure that can be the beginning of a new pedigree for accounting. It is possible to construct the accounting system of the future, which eliminates the disadvantages of existing accounting systems, meets the transparent, reliable and timely information needs of all shareholders and prevents fraud and corruption. Reliable data-based reporting and decision support systems that enterprises have been trying to provide by ERP software for many years may be free from their disadvantages after the blockchain. Smart contracts can perform accounting records in an accurate manner without any intervention, allowing auditors to monitor real-time, transparency will improve, corporate governance can be reinforced by preventing errors and fraudulent operations. In this section, the possible reflections of the blockchain technology to the accounting profession and applications will be addressed from a futuristic perspective.

If the accounting records are kept jointly by enterprises with the Blockchain infrastructure as a digital ledger, both data confidentiality and trust will be ensured by eliminating the differences in the transactions between the enterprises and the reconciliation processes can be ended (Blums & Weigand, 2017). The fact that the records kept in the Blockchain cannot be changed without the consent of all parties will increase the transparency of the operational results (Özdoğan & Kargın, 2018). Scholars have begun designing blockchain based accounting information systems. McCallig et al. (2019) designed a financial accounting information system based on blockchain for both reporting and audit operations. Wang and Kogan (2017) designed a blockchain based transaction system and argue that the system allows real-time accounting and continuous monitoring which increases the transparency with cost effective structure.

The ERP system has the strategic importance of centralizing the data produced of an enterprise's operations and enabling it to use it for decision making within the enterprise. On the other hand, allowing external access to this internal system for any data sharing can lead to significant information security problems. After the integration of Blockchain, access to data in the ERP systems and monitoring permission can only be given to the right users, the data accessed by authorized parties can also be monitored and thus data security can be improved. In this way, for the projects or operations which are carried out jointly by different enterprises, shared ledger access makes it clear that these parties are able to access the ERP system of the enterprise exclusively for the relevant project data. Dai and Vasarhelyi (2017) emphasizes data security, the simplicity of data collection process, need for low human intervention and self-study capabilities of Blockchain system while listing the advantages of Blockchain technology against ERP. When used as an infrastructure in collaboration with ERP systems within the enterprise and in coordination with IoT (Internet of Things) technologies for tracking physical movements, Blockchain technology can maximize precise measurement, monitoring and real-time reporting capabilities of enterprises for all accounting operations (Dai & Vasarhelyi, 2017; Zhang & Wen, 2017).

Besides, although there are concerns about the legal status of smart contracts, many accounting operations can be automated by using it (Raskin, 2017). Operations such as regular procurement, invoicing or credit payment can be kept in the blockchain infrastructure through smart contracts. In this way, both process security and speed can be provided. When used in conjunction with a range of technologies, such as machine learning, smart contracts can lead to complete unmanned bookkeeping and significant cost savings for these operations (Carlin, 2018). Another important role of smart contracts in the integration of the blockchain infrastructure into the accounting system is to ensure that legal regulations and accounting standards are applied to the records after the transactions performed. With the help of smart contracts, the transaction can be realized in full compliance with the relevant standard, legal regulations, and other policies and rules. All transactions can be time stamped, unaltered and traceable by all parties, thus preventing managers from applying for creative accounting practices.

20.5.1 Towards to Triple-Entry Accounting System After Blockchain

Triple-entry accounting system or the real-time accounting system, which covers the largest development so far in order to be implemented in conjunction with Blockchain technology, is one of the concepts discussed extensively in the literature. Although there are researchers who think otherwise (Coyne & McMickle, 2017), many researchers offer their suggestions for possible integration (Dai & Vasarhelyi, 2017; Simoyama, Grigg, Bueno, & Oliveira, 2017; Carlin, 2018).

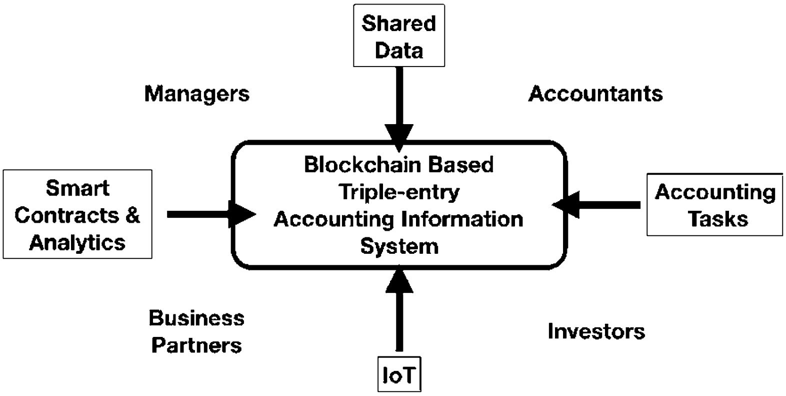

Fig. 20.1 Overview of blockchain-based accounting ecosystem (Adopted from Dai & Vasarhelyi, 2017)

The triple entry accounting system, which discusses it extends to the 80s (Ijiri, 1982; Ijiri, 1986). Current accounting system and regulatory bodies have limited set of tools consist of standards and legal regulations to converge businesses accounting operations as much as possible, to avoid scandals, to reduce errors and fraud, and to minimize the asymmetry of information that investors and other shareholders face within decision-making. However, these tools do not provide a sufficient and definite solution to achieve the stated objectives. Blockchain technology has a technical structure that can provide the elements of coordination, transparency, and accuracy required by accounting.

Due to the triple-entry accounting system, significant limitations of the double-entry system, such as the error-prone structure of it and the necessity to subject additional validation processes to the records held by the parties, can be solved by the blockchain based accounting information system (Grigg, 2005). Dai & Vasarhelyi (2017), argues that using the Blockchain technology for triple-entry accounting system can remove the biggest obstacle to the establishment of the system until now which are accuracy, reliability, safety and irreversibility, and the transparency of transactions (Fig. 20.1).

In addition to the double-entry recording system with the proposed new system, a third digital cryptographically sealed record is created with the blockchain infrastructure and all the details of the transaction that caused the accounting record is kept. That digital ledger is also possible to be viewed by authorized parties. In this system, rather than keeping a third accounting record, it is ensured that the accounting records that are held by the enterprises through the smart contracts are merged into a single shared ledger and the accuracy is confirmed. The system, if implemented, could provide a significant improvement especially in terms of audit processes.

20.5.2 Effects of Blockchain Technology to Auditing

Risk analysis and the accompanying audit framework are essential concepts for eliminating internal inefficiencies of enterprises (Byrnes, Brennan, Vasarhelyi, Moon, & Ghosh, 2015). One of the most fundamental features of the blockchain is to increase the audibility of the information. In addition to mistakes, blockchain technology can also prevent fraudulent accounting and other managerial operations like earnings management (Cai & Zhu, 2016; Fanning & Centers, 2016). While the permission to add a new record to the chain can be given only to the related enterprise or enterprises by means of the private singular blockchain infrastructure, the audit processes can be developed by giving monitoring permission to the external auditing company, legal authority, and the desired institutions or organizations (O'Leary, 2017). In order to improve audit processes, to detect errors and frauds more accurately, external auditing companies attach importance to the use of technology and make significant investments in areas such as big data analysis (Cohn, 2017). The use of blockchain technology in auditing by external auditors will increase the transparency of the audit and the reliability of the audit reports by making the works in the backstage of the audit reports traceable. All the activities and results of the previous audits can be transferred to the new audit company completely and thus the quality of the audit can be increased.

There are three important issues that may lead to disruptions in the current audit processes and the lack of a sound audit. These are data reliability, data security and transaction transparency (Appelbaum & Nehmer, 2017). The audit may become continuous if enterprises keep their accounting records in the blockchain (via smart contracts) and integrate them with ERP systems and give the auditors permission to monitor (Christidis & Devetsikiotis, 2016). In this way, the role of the audit will evolve into the prevention of fraud and corruption from detection. The system, which we can also call as continuous assurance, has long been discussed within the literature by scholars (Alles, Brennan, Kogan, & Vasarhelyi, 2006; Alles, Kogan, & Vasarhelyi, 2002). There are various obstacles to creating a complete control environment through existing ERP systems. Both the users of the ERP system and the IT side have the possibility to deactivate or distort various controls during or after the execution of a transaction. In this case, the process can be seen without any problems (Bumgarner & Vasarhelyi, 2018). However, when a blockchain-based infrastructure is used, it is not possible to make unilateral changes on the transaction or to destroy the process, and the complete process of the transaction can be monitored by authorized parties simultaneously. This infrastructure will open the doors of continuous auditing for internal auditors as well as external auditors. At the same time, the cost of the audit can be significantly reduced and the efficiency can be increased by enabling the remote auditing to be carried out (Byrnes, Criste, Stewart, & Vasarhelyi, 2014).

20.5.3 Potential Affects of Blockchain to Advanced Corporate Governance

Managing all of the accounting operations with Blockchain infrastructure will enable enterprises to gain a more advanced corporate governance structure. Thanks to the technology, investors can see the debt, capital, and partnership structure of companies in a more transparent manner. If companies are asked to keep certain financial records on the public blockchain, fraudulent or creative accounting methods can be reduced (Yermack, 2017). Therefore, significant changes will be observed in the attitudes of executives in earnings management, creative accounting applications, and various financial reporting strategies.

The following statement is under the Disclosure and Transparency heading in the OECD Corporate Governance Principles Guide; "The corporate governance framework should ensure that timely and accurate disclosure is made on all material matters regarding the corporation, including the financial situation, performance, ownership, and governance of the company" (OECD, 2015). The transparency and reliability of the financial statements, which are the main sources of accounting information users, is the most important aspect of the information contained herein. The accounting records and shared ledgers that are kept with the infrastructure of the blockchain will ensure that the prepared financial reports are verifiable, timely and understandable (Blums & Weigand, 2017). Thus transparency and timely disclosure expectations of the shareholders will be fulfilled and the competency of corporations will be increased in terms of Corporate Governance Principles (Piazza, 2017).

Keeping businesses 'stock ownership status in the public blockchain infrastructure will be an important improvement in the name of transparency of ownership processes and can be a solution to key corporate governance problems such as agency problems (Lafarre & Van der Elst, 2018). Thanks to these public digital records, investors will be able to monitor the company's current stock and ownership structure in a much more transparent way. More transparent management of the stock option plans that the companies have defined for their senior executives and employees using smart contracts can be carried out (Yermack, 2017).

20.6 Conclusion

According to a report from DOMO,[1] over 2.5 quintillion bytes of data created every day by the people and by 2020 it is estimated that 1.7 Mb data will be created every second per person. From the number of steps, we take in a day to heart rate statistics, energy consumption ratios to sleeping cycles life of modern *Homo sapiens* have changed irrevocably by benefiting from more and more data every day. This

[1]DOMO, Data Never Sleeps 6.0 Report available at: https://www.domo.com/learn/data-never-sleeps-6

transform of using data has changed the way we do business as well. While the strategic importance of having data for today's entities is slightly reduced and became a regular business process, the challenge today is to use the data as much as it can be and transform it into a driver of competitive advantage. Blockchain technology in its simplest form ensures the timeliness, accuracy, and transparency of the data produced in a business which can pave the way for various benefits including operational effectiveness to cost efficiency. As Pacioli mentioned in his Summa, "You need to know more to be a good merchant than to be a doctor of law". Accounting since the primitive methods is always in a search for more effective ways of transforming data into significant decision tools.

After the Nakamoto's white paper about cryptocurrency Bitcoin and its infrastructure based on distributed ledgers, blockchain technology has become one of the most discussed phenomena on a wide perspective including various sectors and businesses as well as accounting. From a shareholder perspective, accounting information has effects on the decisions of a broad group of related parties. Potential accounting applications based on blockchain technology as discussed in this paper may provide significant benefits to businesses. It can reduce the time and cost of transactions between companies as well as ensuring the transparency and accuracy. Using smart contracts for automating various transactions and cryptographic shared ledgers for keeping accounting records have the potential of ensuring both time and cost reductions in accounting operations and real-time reporting opportunity for management. On the other hand, giving authorization of monitoring transactions on blockchain to the auditors of the company and legal institutions can significantly reduce the cost of the audit and improve the quality of audit by enabling the real-time assurance concept. Since the technology is still in the early stages of acceptance, it is important to support design proposals and researches of scholars on potential effects of technology to the business environment as well as discussing the legal status and regulations that can pave the way for the new pedigree in accounting and other functions of the business.

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Chapter 21
A Critical Approach to Accounting in the Digital Era: Assessment of the Impacts of Industry 4.0 on Financials

Vildan Evrim Altuk and Ali Kablan

Abstract The Information Age has led to the emergence of Industry 4.0 with rapidly developing technological devices making the data collection process much easier. Industry 4.0, which is also called the Second Machine Age, is expected to shorten the process, reduce margin of error and costs with the inclusion of self-learning robots in the production process. This shift will definitely have an impact on financial statements which depict the performance of a business organization. In addition, the items in a financial statement will undoubtedly change because of the use of virtual money, just-in-time production, and the decreasing role of humans in the production process being replaced by robots. In consequence, the financial analysis ratios will be modified in accordance with the changes in financial statements. This chapter focuses on the effects of Industry 4.0 on financial statements and financial statement analysis from a theoretical perspective. The possible effects of developing information technologies on financial statements and ratio analysis will be discussed.

21.1 Introduction

Globalization introduced a series of economic, social political and cultural innovations, and proved that it will force existing institutions and competition rules to change (Kuzu, 2019). It also helped IT technologies to spread easily around the world.

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IT infrastructure and services are now available thanks to the cloud network and smart devices taking over the role of traditional PCs. Microcomputers (embedded systems) are gaining more power and autonomy day by day and are now able to network with each other, which results in the integration of virtual elements into the physical world (Kagermann, Wahlster, & Helbig, 2013).

From a historical perspective, industrial revolutions have not only led to fundamental changes in production but they have also redefined the functions of the organization. Following the Ages of Steam, Electricity and Information, the Age of Cyber Physical Systems is called Industry 4.0 (Xu, Xu, & Li, 2018).

It is beyond doubt that there will be certain impacts of Industry 4.0 and the digital age on accounting systems and financial statements. Financial statements are one of the most important tools to inform shareholders about the business organization and help them transform the available information into data-driven decision-making processes.

21.2 The History of Industrial Revolutions

People survived as hunter-gatherers until about B.C. 10,000 before they settled and began to perform agriculture and livestock breeding, which marked the beginning of the "Agricultural Revolution" (Özkan, Al, & Yavuz, 2018: 4). The agricultural revolution turned consumer societies into productive ones and led to an increase in population, developments in arts and architecture in city life while introducing the concept of private property and new regimes (Özsoylu, 2017: 42). The agricultural revolution was followed by the "Industrial Revolution" which began with the invention of steam engines during the mid-eighteenth century in England and spread to Western Europe, North America and finally to the whole world (Davutoğlu, Akgül, & Yıldız, 2017: 544). The first industrial revolution, which is also called Industry 1.0, was marked by the replacement of man power by machines, developments in transportation and the increasing use of metals (Davutoğlu et al., 2017: 547).

Industry 1.0 paved the way for Industry 2.0 which introduced the use of electric power and assembly lines as the most important features of the second industrial revolution during the mid-nineteenth century. With the use of electric power, Henry Ford developed the assembly line for mass production of automobiles, which increased the production volume while reducing costs and prices (Özkan et al., 2018: 5).

Besides the use of electric power, the development and use of tools, such as telegraphs, telephones, radio and typewriters during the second industrial revolution made communication much faster and more effective, thus reducing the physical distances (Pamuk & Soysal, 2018: 42).

The second industrial revolution was followed by the "Third Industrial Revolution", which was marked by the invention and use of programmable machines in production (Davutoğlu et al., 2017: 547). The use of computers and the

Internet along with developments in communication and transportation led to positive outcomes in production while introducing the products which are much smaller, mechanical and practical into daily life. It also de-emphasized the use of man-power and business enterprises began to give weight to customer satisfaction. The developments and progress during Industry 3.0 are considered to bring forth Industry 4.0, which is also called the "Fourth Industrial Revolution" (Görçün, 2017: 141).

The advances in technology and communication at the beginning of the twenty-first century have extended the use of the Internet, while developments in software have led to the emergence of smart systems. The Fourth Industrial Revolution is marked by new production systems that need no humans for production and that can connect physical and digital systems (Soylu, 2018: 45). Industry 4.0 is based on production and distribution systems using machines that need no manpower and that operate and monitor automatically in coordination with other machines.

21.3 Industry 4.0

The developments in technology have greatly increased industrial productivity since the beginning of the industrial revolution. The first industrial revolution took place in the late eighteenth century with the use of steam engines in factories. In the early twentieth century, the second industrial revolution started as electricity paved the way for mass production. During the 1970s, automation became widespread with the use of electronic systems and information technologies (IT), which marked the third industrial revolution. Today, all of these are being replaced by cyber-physical systems and dynamic data processing where the value chain has end-to-end connectivity (TÜSİAD Raporu, 2016). The first three industrial revolutions were the products of mechanization, electricity and IT, respectively, and now, the introduction of Internet of Things and Services into the production process is about to produce a fourth industrial revolution (Kagermann et al., 2013).

Industry 4.0, which originated in Germany, refers to the rapid transformation of production systems (Davies, 2015). In an Industry 4.0 factory, all participants are interconnected and the exchange of information is uninterrupted (Schlechtendahl, Keinert, Kretschmer, Lechler, & Verl, 2015). Objects, which are placed at the center of Industry 4.0, refer to anything that is physical such as devices, accessories, etc. They can make decisions using "Artificial Intelligence" which operates with informatics-communication software and hardware embedded into the objects (Banger, 2017).

This very new process is about to revolutionize production-consumption relationships as a whole. The production systems adapting themselves to the changing needs of consumers and the interconnected automation systems working in coordination with each other will probably be the characteristics of the new era (Alçın, 2016).

The aim of Industry 4.0 is to achieve an operational level of automation for higher productivity and efficiency and it will lead to the emergence of new manufacturing processes that incorporate machine capability and human intelligence (Thames & Schaefer, 2016).

21.4 Components of Industry 4.0

There are several components of industry 4.0. The components are limited to four in the context of this chapter. They are Cyber Physical Systems (CPS), Internet of Things (IoT), Big Data and Smart Factories.

21.4.1 Cyber-Physical Systems

A cyber-physical system (CPS) is a composition where the physical processes are directed by both cyber and physical parts of the system. The physical processes are monitored and controlled by the computers and networks providing feedback (Lee & Seshia, 2017).

The creation of smart factories within the context of Industry 4.0 will be possible with CPS. CPS has two dimensions, which are the huge physical system made up of smart and communicative machines (workbenches, devices, etc.) in the CPS and the simulation of the physical system on IT media. While the physical system continues to work in the real environment, a copy of the process runs in the IT environment, where the preliminary studies for maximum performance of the physical system are carried out (Banger, 2017).

In the future, physical plant operations will also be performed with the help of simulations. Real-time data improved by these simulations will be used to mirror a real model of machines, products and even humans in a virtual environment. So, the machine settings for the next product in line will be tested and optimized before it is manufactured, which will also reduce the machine set up times and increase quality (Rüßmann et al., 2015).

21.4.2 Internet of Things

Our lifestyles have drastically changed with the Internet as it moved professional and social interactions to a virtual level. This process can take on a new significance as communications are possible with the use of smart objects, which makes it possible to communicate "anytime, anywhere, any media and anything" (Atzori, Iera, & Morabito, 2010).

The Internet of Things (IoT) refers to things that are connected to the Internet and each other, such as tablets, computers, smart phones, bulbs or door locks. These objects operate with the use of electronic circuits embedded into them or Radio

Frequency Identification (RFID) (Greengard, 2015). The term IoT was first coined by Ashton during a presentation in 1999 (Ashton, 2009; Greengard, 2015). According to Ashton (2009), almost all of the data on the Internet is a result of people's actions and people's time and knowledge and data entry is quite limited. Therefore, human and machine data entry would be more accurate than human data entry (Greengard, 2015). Kellmereit and Obodovski (2013) claim that the union of human and technology will be insurmountable. IoT also creates opportunities for businesses to increase productivity and profitability and reduce costs (Ahmed et al., 2017).

21.4.3 Big Data

The term big data and its analyzability have become a current issue because of the excessive amount of data collected with the use of IoT. The introduction of Big Data into the process will definitely affect the way data is accumulated and recorded, which will reshape the organizational goals defined by management, and the way reporting elements are processed and assembled (Warren, Moffitt, & Byrnes, 2015). Future factories will greatly benefit from Big Data analytics with respect to providing customers with new products (Shrouf, Ordieres, & Miragliotta, 2014).

Big Data can be used to improve the transparency and usefulness of financial information (Warren et al., 2015). With IoT, non-financial information can be reorganized and integrated into financial reports.

21.4.4 Smart Factories

Smart factories are one of the main components of Industry 4.0. A smart factory is a system in which all manufacturing resources such as sensors, robots, and machines are interconnected for automatic information exchange (Qin, Liu, & Grosvenor, 2016). The "Smart Factories" of Industry 4.0 can detect the need for work with sensors and connect to other production tools through the Internet. So, the information needed for production can be retrieved from Big Data in cloud systems by using smart machines and systems (Alçın, 2016).

With the smart products of smart factories, collection and analysis of data obtained from the smart product users will be possible. So, customer behaviors and needs will be better defined and new and more sustainable products and services will be provided (Shrouf et al., 2014).

21.5 Effects of Industry 4.0 on Financial Statements

21.5.1 Financial Statements

IAS 1 Presentation of Financial Statements specifies that a complete set of financial statements comprises a statement of financial position, statement of profit or loss and other comprehensive income, statement of changes in equity, statement of cash flows and notes including significant accounting policies and other information.

Statement of financial position describes the resources of a firm (assets) and the claims on those resources (liabilities and shareholders' equity) on a specific date (Wahlen, Baginski, & Bradshaw, 2015). According to IFRS, the statement of financial position should be presented based on the short- and long-term analysis or liquidity basis (Örten, Kaval, & Karapınar, 2017).

The statement of profit or loss is a source of information about the profitability of a firm for a period of time (Wahlen et al., 2015) and it shows whether the company's operations are successful or not (Weygandt, Kimmel, & Kieso, 2015). The income and expenses that are not included in profit or loss comprise other comprehensive income (IASB, 2014).

The changes in the status of ownership should be presented in the statement of changes in equity, which includes the increase and decrease of capital, capital reserves, profit reserves, and distributed profits (Uyar, 2015). The changes in each equity account and total equity are presented in the statement of changes in equity (Weygandt et al., 2015).

The cash receipts and payments for a specific period of time are presented in the statement of cash flows (Weygandt et al., 2015). The aim of the statement of cash flows is to provide information about the cash inflow and outflow. The cash flow resources and uses in the statement of cash flow are divided into three subtitles, which are business, investment, and financing activities (Subramanyam & Wild, 2009).

The additional information is presented in the notes in the financial statements (IASB, 2014). Footnotes supplement the financial statements and give information about the accounts which are not detailed in financial statements. They also clarify the financial statements making the decision-making process more reliable (Uyar, 2015).

In order to benefit from financial statements, financial information must faithfully represent economic phenomena. To be a perfectly faithful representation, a depiction would be complete, neutral, and free from error (IASB, 2018). Thus, Industry 4.0 tools will gain importance for the fair presentation of financial statements, as the analysis of big data will provide users with accurate and opportune information.

Kaya and Akbulut (2018) state that although the nature of accounting and financial reporting do seem the same, the traditional methods of recording, data collection and analysis will definitely change with the introduction of big data analytics into accounting. We anticipate that big data analytics will change the content or significance of items in the financial statements, thereby affecting financial ratios.

In the following, the impacts of industry 4.0 on the statement of financial positions and on the statement of profit or loss are discussed.

21.5.2 Impact of Industry 4.0 on Statement of Financial Position

21.5.2.1 Cash and Cash Equivalents

According to IAS 7 Cash Flow Statement, cash is the total of cash on hand and demand deposits. Cash equivalents, on the other hand, are short-term investments with high liquidity that are readily convertible to cash (IASB, 2017).

Today, most trade and money transfers are conducted through the Internet (Khalilov, Gündebahar, & Kurtulmuşlar, 2017). Moreover, cashierless stores, such as Amazon's "Amazon Go", are operating and will dominate the future. With the use of cameras and sensors, the goods people buy are counted; what people do is just to use Amazon Go app, shop and go home. Your credit card is automatically billed without waiting in line as you go out. You can get the receipt from the app in a short time, including the details of your payment and even your stay in the shop (Liao, 2018; McFarland, 2018). In line with such technological developments, the ways of payment will also undergo some changes, which may abolish cash entirely because of cash registers without cashiers and cash payment.

Today, many people and constituencies can access technology that is used for the creation of digital currencies where a complex set of algorithms is minted by servers working in an almost lawless way, which are called Blockchain (Scardovi, 2017). As in the case of the Bitcoin example, this technology will give birth to many other BlockChain applications (Schwab, 2016). Bitcoin can be exchanged for fiat money as well as other cryptocurrencies (Khalilov et al., 2017). Digital currencies can be created, exchanged and verified with a digital system where distributed ledgers are used as the final certifier of the trade (Scardovi, 2017).

Serçemeli (2018) states that digital currencies are recorded in three ways by companies that trade cryptocurrencies, which are foreign currency, precious metals and financial instruments that can be recorded. Therefore, cryptocurrency will be classified either as cash or as financial instruments, which will influence the statement of financial positions.

21.5.2.2 Impact on Inventories

One of the biggest contributions of Industry 4.0 is the concept of just-in-time (JIT) production. Goods will be produced and transported to customers at the moment they are needed thanks to the analysis of Big Data obtained through IoT.

JIT purchasing is the purchase of goods so that they are received just as they are needed to meet customer demand. JIT production is a manufacturing system where each component of the production line is manufactured immediately and only when required by the next stage of the process. The aim of JIT production is to lower the costs of inventories as well as improving quality by diminishing the causes of rework, scrap, waste and lowering manufacturing cycle times (Horngren, Datar, & Rajan, 2015). The customers can engage in designing products thanks to the IoT technology (Shrouf et al., 2014).

Although analysis of large data sets is a recent development, it was used to optimize production quality, save on energy and improve equipment service. So, the evaluation of data collected from different sources will also be used in the Industry 4.0 context as it assists the real-time decision-making process (Rüßmann et al., 2015).

Introduced by Industry 4.0, Smart products are products empowered with mechatronic systems that can communicate with each other through the Internet and monitor physical processes. These interactive products can gain awareness of their surroundings and operational states so they can make decisions and trigger events (Reiner, Picard, & Albrecht, 2013). Smart products will be able to connect with other smart products through IoT. For instance, the fridge will send an e-mail to users informing them about the amount of food it contains or whether the food is fresh or not (Görçün, 2017). The users will do their shopping based on the demands of smart products and the supermarkets; in this case, smart factories will start just-in-time production based on the reports coming from supermarkets.

The companies which are ahead of their competitors can begin production on demand without additional costs. The flexibility of the production amount and the production on demand without storage is critical for the adjustment of production volume (Banger, 2018).

Also, the use of full-time inventory management may help decrease stock costs with the optimum time and amount of orders.

21.5.2.3 Impact on Fixed Assets

With the emergence of smart factories, smart machines and robots will be a part of the production process, which will increase fixed asset investments. So, the representation of fixed assets with their market values on financial statements will gain more importance. Because the fixed assets will be able to communicate with other fixed assets with their sensors, estimate their own value, make more reliable predictions for their useful lives, choose the best depreciation method and adapt their predictions when needed.

21.5.2.4 Impact on Intangible Assets

Big data can help us understand the nature of intangible assets and plays a vital role in allowing soft assets appear in the actual financial statements with the use of quantitative valuation methods (Warren et al., 2015).

Today, many companies are investing in Industry 4.0 and the Internet of Things (Görçün, 2017) and they will also keep investing in software to benefit from IoT, too. As a result of the recognition of software that is needed for technological investments, especially Rights Accounts will be an important part of intangible assets.

21.5.2.5 Impact on Short-Term Liabilities

According to IAS 1 Presentation of Financial Statements an entity shall classify a liability as current when it expects to settle the liability in its normal operating cycle; it holds the liability primarily for the purpose of trading; and the liability is due to be settled within twelve months after the reporting period (IASB, 2014).

The amount of production labor is very likely to decrease with smart factories and mechanization of Industry 4.0. Therefore, the accounts Payables to Employees within the short term liabilities will probably decrease, which will be followed by declines in staff expenses, social insurance payments and provisions for termination indemnities. On the other hand, it seems difficult to predict whether the amount of executive labor and qualified personnel costs and the number of white-collar workers will increase or not in the course of time. Also, the use of full-time inventory management with stock tracking and control systems will probably decrease the inventory costs, and thus debts to suppliers.

21.5.2.6 Impact on Long-Term Liabilities

According to IAS 1 an entity shall classify all other liabilities that are not current as non-current (IASB, 2014).

Because of the technological transformation with Industry 4.0, there may be an increase in long-term liabilities and financial expenses due to fixed assets including technology and software investments.

21.5.2.7 Impact on Shareholders' Equity

As in the long-term liabilities, the technological transformation with Industry 4.0 will lead to an increase in the technology and software investments, which will also affect the preferences of companies for financing the investments in long-term assets with shareholders' equity (Tables 21.1 and 21.2).

Table 21.1 The impact of Industry 4.0 on statement of financial position

Statement of financial position			
Current assets		*Current liabilities*	
Cash and Cash Equivalents	↓	Short term borrowings	—
Financial Assets	—	Trade and other payables	↓
Trade and Other Receivables	—	Current income tax liabilities	↓
Inventories	↓	Short term provisions	↓
Non-current assets		*Non-current liabilities*	
Financial Assets	—	Long term borrowings	↑
Property, plant and equipment	↑	Long term provisions	↓
Intangible Assets	↑	*Equity*	
		Paid-in share capital (Investments for fixed assets)	↑

Table 21.2 Impact of Industry 4.0 on statement of profit or loss

Statement of Profit or Loss	
Gross Sales	↑
Sales Deductions (-)	↓
Net Sales	↑
Cost of sales (-)	↓
Gross profit or loss	↑
Operating expenses (-)	↑
Other operating income	—
Other operating expenses (-)	—
Operating profit or loss	↓
Financial income	—
Financial expenses (-)	↑
Profit or loss before tax	↓
Current income tax expense (-)	
Profit or loss for the period	↓

21.5.3 Impact of Industry 4.0 on Statement of Profit or Loss

With the developments in technology, there will probably be a decrease in the cost of sales because of productive labor, decreasing inventory and material costs. Customer-driven production will help companies reduce the number of sales returns, which will boost sales productivity. However, the operating costs may increase due to the depreciation expenses of the investments in long-term assets, which may also decrease the operating profitability. In addition, ordinary profitability and period income may decrease because growing investments means increasing the amount of financing expenses.

21.6 Impacts of Industry 4.0 on Ratio Analysis

21.6.1 Ratio Analysis

Ratios are mathematical expressions of the relationship between items. Ratio analysis is a method where financial statements are used to analyze a company's position and performance to make better decisions for the future (Robinson, van Greuning, Henry, & Broihahn, 2009; Subramanyam & Wild, 2009). Ratio analysis reveals the relationships between the accounts in profit or loss statements and the statement of financial position.

The ratios that are likely to be affected by the introduction of Industry 4.0 are discussed below.

21.6.1.1 Liquidity Ratios

Liquidity ratios are metrics that are used to measure a company's ability to meet its financial obligations, evaluate the risk of liquidity, and determine whether the net working capital is positive or not (Akgüç, 2017). A company should stabilize its short-term liabilities and current assets in order not to have difficulty with debt repayment (Karapınar & Zaif, 2016).

Current Ratio This ratio is a short-term measure that is used to compare current assets with current liabilities to assess a company's liquidity position (Elliott & Elliott, 2006). The current ratio shows the proportion of current assets to current liabilities.

$$\text{Current Ratio} = \frac{\text{Current Assets}}{\text{Current Liabilities}}$$

Current assets are used for the operating business and are usually sold, consumed, or exhausted within a year. Short-term liabilities are also characterized by a period of less than a year, which indicates that these liabilities should therefore be sufficiently covered by their counterparts on the asset side, current assets (Schmidlin, 2014).

Quick Ratio (Acid-Test Ratio) This ratio measures whether a company can meet its short-term obligations or not with respect to its most liquid current assets.

$$\text{Quick Ratio} = \frac{\text{Cash} + \text{Short-term marketable investments} + \text{Receivables}}{\text{Current Liabilities}}$$

The quick ratio, which is also called the acid-test ratio, is the ability of a company to pay its current liabilities with only its current assets which the company could convert into cash, often within 90 days. Cash, marketable securities and other short-term investments, and receivables are considered quick assets (Wahlen et al., 2015).

Cash Ratio The cash ratio is a measurement of a company's liquidity. It shows a company's ability to repay its debt. The cash ratio is a company's ability to pay off its current liabilities with cash and cash equivalents (Karapınar & Zaif, 2016).

$$\text{Cash Ratio} = \frac{\text{Cash} + \text{Short-term marketable investments}}{\text{Current Liabilities}}$$

21.6.1.2 Debt Ratios

The debt ratio measures the relative amount of liabilities, particularly long-term debt, in a firm's capital structure; and the higher it is, the greater the long-term solvency risk (Wahlen et al., 2015). There are two basic ratios that reveal the financial structure of a company, which are financial leverage and debt to equity ratio indicating the relationship between the shareholders' equity and liabilities (Karapınar & Zaif, 2016).

Debt to Asset Ratio This indicates the percentage of a company's assets that are being financed by liabilities (Akgüç, 2017), which is calculated as follows;

$$\text{Debt to asset ratio} = \frac{\text{Total liabilities}}{\text{Total assets}}$$

In developing countries, a percentage above 50 is considered normal because of difficulties in the capitalization of shareholders' equity, current assets holding a high percentage of the total assets and the use of more labor-intensive technologies (Akgüç, 2017).

Debt to Equity Ratio This measures the amount of total liabilities relative to equity. Higher debt to equity ratio is interpreted as weaker solvency (Robinson et al., 2009). The optimum debt-to-equity ratio is considered to be around 1 while higher ratios indicate that the company may not be able to repay its debt obligations or meet its interest expenses (Akgüç, 2017).

$$\text{Debt to equity ratio} = \frac{\text{Total liabilities}}{\text{Shareholders' equity}}$$

21.6.1.3 Activity Ratios

The aim of activity ratios, also known as asset utilization ratio or operating efficiency ratio, is to assess how efficiently a company manages its various assets (Robinson et al., 2009).

Inventory Turnover Inventory turnover measures how quickly a company could convert its inventories into sales (Akgüç, 2017).

$$\text{Inventory turnover} = \frac{\text{Cost of sales}}{\text{Average inventory}}$$

Inventory turnover indicates the assets based on the inventories, and it can be used to measure the efficiency of inventory management (Robinson et al., 2009). A high ratio may imply either high profitability or that the assets invested in the inventories are relatively low (Akgüç, 2017).

Asset Turnover Ratio The asset turnover is a measure of the efficiency of a company's ability to use its capital asset base for generating sales (Elliott & Elliott, 2006; Robinson et al., 2009).

$$\text{Assets turnover} = \frac{\text{Net sales}}{\text{Average assets}}$$

Asset turnover indicates the relative importance of assets within the active structure of a company. In a company, a high percentage of fixed assets within the total amount of assets shows that the asset transfer is relatively slow, while a low percentage, as in some industry sectors where fixed assets are relatively unimportant, indicates faster asset transfer (Akgüç, 2017).

Shareholders' Equity Turnover This ratio shows how productively the shareholders' equity is used.

$$\text{Shareholders' equity turnover} = \frac{\text{Net sales}}{\text{Average shareholders' equity}}$$

The higher the ratio is, the more productively and economically the shareholders' equity is used and the more liabilities are used (Akgüç, 2017).

21.6.1.4 Profitability Ratios

Profitability ratios, for a given period, measure the operating success of a company (Weygandt et al., 2015).

Gross Profit Margin Gross profit margin indicates the percentage of revenue available to cover operating and other expenditures. Higher gross profit margin indicates some combination of higher product pricing and lower product costs. On the cost side, higher gross profit margin can also indicate that a company has a competitive advantage in product costs (Robinson et al., 2009).

$$\text{Gross Profit Margin} = \frac{\text{Gross profit}}{\text{Net sales}}$$

Operating Profit Margin This ratio shows to what extent the company's activity is profitable. If it is high or it tends to go up, then a positive evaluation can be made (Akgüç, 2017). Operating margin is calculated as follows:

$$\text{Operating Profit Margin} = \frac{\text{Operating income}}{\text{Net sales}}$$

The impacts of Industry 4.0 on financial ratios are explained in Table 21.3:

21.7 Conclusion

Industry has evolved since the introduction of mechanical manufacturing equipment, which led to the mass production of goods with electricity. Then the automation process shaped the current industrial age. In this period, technological advances have changed the production process dramatically. The intercommunication between humans, phones, machines and almost anything has laid the way for Big Data, which has already created better production opportunities for companies. In addition, self-operating, intercommunicative and self-learning machines will definitely make their mark on the near future. Companies will determine exactly what, when and how much to produce with the analysis of big data, which will enable them to work with just-in-time production systems as they manufacture only the amount needed.

The analysis of data obtained from endorsements, the number of inventories, profitability values, costs of raw material, labor and overtime, etc. will yield better predictions for the future.

The conformance of accounting to Industry 4.0 will decrease errors and fraud, which will produce financial reports of high quality. The ratios used in financial analysis will provide users with more reliable information.

Table 21.3 Impacts of industry 4.0 on financial ratios

Liquidity ratios			
Current ratio	$\frac{\text{Current assets}}{\text{Current liabilities}}$	↓	Companies using full-time inventory management with the introduction of Industry 4.0 will carry out just-in-time production. Thus, based on the assumption that the decrease in the current assets is bigger than the one in short-term liabilities, it is suggested that the current ratio may decrease
Quick ratio (Acid-test ratio)	$\frac{\text{Cash+Short-term marketable investments+Receivables}}{\text{Current liabilities}}$	↓	Based on the assumption that a company uses just-in-time production, the quick ratio loses its purpose and it may move closer to the current ratio
Cash ratio	$\frac{\text{Cash+Short-term marketable investments}}{\text{Current liabilities}}$	↓	The cash ratio should be able to be converted into cryptocurrencies
Debt ratios			
Debt to asset ratio	$\frac{\text{Total liabilities}}{\text{Total assets}}$	↑	Based on the assumption that financing will be obtained from long-term liabilities due to increasing investments in fixed assets as a result of Industry 4.0, there may be an increase in the financial leverage ratio
Debt to equity ratio	$\frac{\text{Total liabilities}}{\text{Shareholders' equity}}$	↑	Based on the assumption that shareholders' equity will be insufficient to afford the obligations as a result of investments in fixed assets and that non-current liabilities will be used, there may be an increase in the non-current liabilities
Activity ratios			
Inventory turnover	$\frac{\text{Cost of sales}}{\text{Average inventory}}$	↑	Based on the assumption that a company adopts a customer-oriented and just-in-time approach, inventory turnover will make no sense. In other words, the production and sales of stock will be carried out simultaneously

(continued)

Table 21.3 (continued)

Liquidity ratios			
Assets turnover	$\frac{\text{Net sales}}{\text{Average assets}}$	↓	It can be assumed that the increase in the investments in fixed assets will be larger than the increase in net sales, which will decrease the asset turnover
Shareholders' equity turnover	$\frac{\text{Net sales}}{\text{Average shareholders' equity}}$	↓	Based on the assumption that the financing of the fixed asset investments will be provided by shareholders' equity and that this increase will be larger than the increase in net sales, there may be a decrease in the shareholders' equity turnover
Profitability ratios			
Gross profit margin	$\frac{\text{Gross profit}}{\text{Net sales}}$	↑	Based on the assumption that the sales returns and cost of sales will decrease, it is suggested that gross sales margin and net sales will increase
Operating profit margin	$\frac{\text{Operating profit}}{\text{Net sales}}$	↓	Based on the assumption that the increase in depreciation expenses in parallel with the long-term assets leads to a decrease in the operating profitability, it is suggested that operating profitability will decrease

Consequently, the change in the items in financial statements and the ratios underlying the analysis will gain wider currency. So, they will either increase or decrease in line with the recent developments.

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Chapter 22
How to Use Blockchain Effectively in Auditing and Assurance Services

Ipek Turker and Ali Altug Bicer

Abstract The last decade has been quite innovative and revolutionary for both digital tools and financial reporting. Until now, auditing and assurance services have dealt with sorting mountains of data. With firms upgrading their business methods and internal control systems through the use of information technologies, it has become mandatory for those same information technologies to be used in auditing and assurance services. Accordingly, the quality of auditing has increased, taking out what used to be a drudgery for auditors. However, at the same time new areas of auditing and assurance services have opened up.

There has been speculation about whether the accounting information system will replace what accountants do, that is, whether blockchain systems will replace auditors. It is undeniable that when used in the audit process, blockchain systems increase the quality of the audit without increasing the time spent on the audited data. In some articles blockchain is referred to as one open, unmodifiable ledger. When auditing financial reports based on this ledger, auditors are able to increase the number of samples they use, even up to including the entire data set without increasing their work-load or the time necessary to audit the integrity of the data. However, this introduces new technological and business risks that the auditor will need to assess.

International Auditing Standards have not yet been revised in terms of how and when to use blockchain ecosystems and the risks that they create for external and fraud audits. This chapter will explain how and when to use blockchain technologies and identify the potential new risks that await the auditor. Since no definitive rules and regulations have yet been made, this study is based on the opinions of several

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professional bodies that are currently tackling bitcoin and other sub-tools that blockchain ecosystems are offering.

22.1 Introduction

As we move forward in Industrial 4.0, we face the need to reassess and redefine the terms “accounting” and “auditing”. The changes brought about by Industrial 4.0 are not confined to technology but include the need to redefine certain fundamental elements that form the building blocks of “accounting” and “auditing” such as “value”. The science of accounting has remained pretty much the same for centuries, since Luca Paccioli first wrote *Suma Matematica*. The classic, narrow text book description sees accounting as classifying, recording, summarizing and reporting the economic transactions of a company that can be measured with any given currency. One of the main questions that arises within Industrial 4.0 regarding blockchain technologies is whether these technologies will end the accounting profession and, in particular, that of the auditor.

Returning to the accounting definition and taking a closer look at accounting theory, we would like to underline the fact that “money is measurement”, and double underline the term measurement; even the word accounting has “counting” in it. But what does the accountant count? And what does the auditor audit? To answer these questions, we need to take a look at the two scientists who lived centuries apart and practiced completely different branches of science. One is Galileo Galilei, who said, “Measure what can be measured, and make measurable what cannot be measured”. And the other is Peter Drucker, who said “What’s measured improves”. Around 500 years separates the two scientists and yet they both emphasize the importance of measuring. Now we would like to introduce a third scientist, one even older than these two, with another quote from Galileo “If I were again beginning my studies, I would follow the advice of Plato and start with mathematics”. Plato, roughly 1800 years before both scientists (give or take a century), argued for the merits of learning to calculate with these words. Of course, Plato was arguing that mathematics is basic calculation and counting, while we will be arguing for its application to the accounting profession and auditing.

In this chapter we will study theoretically how Industrial 4.0 is expected to affect the accounting profession and consider the expected impact of this effect on auditing financial reports.

22.2 Accounting 4.0

To make it simpler we will draw the timeline for accounting within the Industrial Revolutions, beginning with the first and the advent of the steam engine. However, in order to get into accounting theory and philosophy, we need to understand the need for it and the changes in the business world that it demanded. In the simplest terms, accounting can be defined as the common language that is used inter-departmentally and between companies in order to communicate. This language of accounting has evolved (and is still evolving) throughout the centuries in parallel with management theories. We will see on the one hand how accounting has changed and on the other hand how it has failed to change within itself, continuing with the same consistency as it did centuries ago. As we are talking about accounting within Industrial 4.0, let us divide the timeline accordance to the industrial revolutions beginning with the first.

Steam power enabled societies to move forward economically. The steam engine not only meant trains, which meant that trade became easier logistically, but the same engine, working on the power of coal, meant mass production could be developed. And this meant economic advances, and the concept of advancement or of measuring company success was the use of simple profit calculations. Income minus cost and expenses. This was the generally understood measure of success, although it was not necessarily transparent. Now here we are in a bit a dilemma: the philosophy and ethics of accounting is "social responsibility". However, this does not materialize until much later.

Then came the second revolution, the new technological advances that resulted from the new source of energy, electricity. This led to the development of large factories, which broadened the understanding of organizations forcing managements to rethink their operations. Electricity also led to the introduction of the telephone to human lives and airplanes to the transportation system. But still, success was measured by simple rates of profit.

Revolution 3.0 was the advent of nuclear power, which brought us the computer and computing. Also, it introduced a high-level of automation to the production process: automatons and robots. Around the beginning of this era, Milton Friedman introduced the shareholder theory. As he said in his 1970 *New York Times* article (Friedman, 1970):

> There is one and only one social responsibility of business: to use its resources to engage in activities designed to increase its profits so long as it stays within the rules of the game, which is to say, engages in open and free competition, without deception or fraud.

Until Friedman's shareholder theory, people loosely followed Adam Smith's theory of the laissez-faire, or the free market, but now Friedman was pointing in a new direction: It was all about maximizing the shareholders' interest—within legal means of course.

So, we should pause and take a look at accounting and the accountant and then the auditor, and, most importantly, what is expected from them and the profession. As economic developments and industrial revolutions moved on, the "economic transactions" referred to became more intricate and complicated. The inter-departmental role of accounting became more and more vital, particularly with larger factories and bigger volumes of production. In addition, high yield in many cases meant high risk and this risk fell on the shoulders of accountants and auditors, particularly with the accounting principle of "going concern".

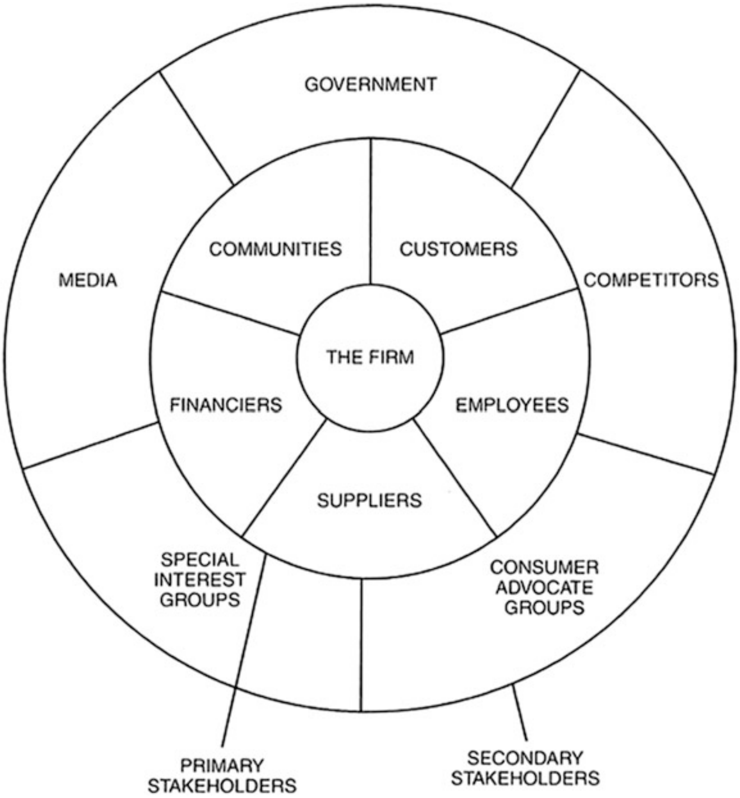

Fig. 22.1 Creating value for stakeholders. Source: R. Edward Freeman, Jeffrey S. Harrison, and Andrew C. Wicks (2007). Managing for Stakeholders: Survival, Reputation, and Success. New Haven: Yale University Press. Originally from a conversation with Robert Phillips

We aren't going to delve deep into stakeholder theory in this chapter since it is not our main study; however, a brief overview is helpful. Stakeholder theory entered into scientific literature as a term in a 1969 Stanford research study, from which it then developed over the years through organization theory. It took its current form in the 1980s from Edward Freeman. In essence, the stakeholder approach to business is about creating as much value as possible for stakeholders, without resorting to trade-offs (Jones, Wicks, & Freeman, 2017). The theory involves the primary and secondary stakeholders that are included in the Creating Value for Stakeholders Wheel (Fig. 22.1).

From this wheel we see the firm as a small circle in the middle. However, from an accounting perspective, the firm is not just a simple circle but has many sub-departments that use and need accounting as a source of information. Thus today, we describe accounting as an information system.

Regardless of the narrow description of accounting throughout the decades, accounting has always been the main decision-making mechanism, whether from an internal or external decision making point of view.

We can say that the introvert structure of companies has shifted into more extrovert structures, regardless of their sector. And speaking of sectors, let's look at the "most valuable companies" according to Forbes Magazine 2018. It is not a coincidence that the first five are digital or technology companies, as shown below from first to fifth (Forbes, 2018):

- Apple
- Google
- Microsoft
- Facebook
- Amazon

When there is so much demand for technology, it is no wonder that topics such as "Information Technologies" and "Information Availability" have become central to Industrial 4.0. This increased demand has shifted the basic structure of information that is needed by companies both internally and externally.

22.3 Accounting Information Systems: From Data to Information and then to Knowledge

Here we would like to bring in the human thinking concept "from data to wisdom" from the system theorist and organizational change professor, Russell Ackoff (Bellinger, Castro, & Mills, 2004):

- **Data**: For the human mind, unprocessed data is symbols.
- **Information**: This processes the data and answers these questions: Who, What, Where, When
- **Knowledge**: This answers the question "How", as applied to unprocessed and processed data.
- **Understanding**: Whilst this answers the question "Why", it is also the appreciation of the answer to Why.
- **Wisdom**: Wisdom comes from experience.

Before we go further into the subject, it is worth looking at a comparison of the terminology. According to the Oxford Dictionary (Oxford, 2019), "data" is a philosophical Latin term and the plural form of "datum", which stands for:

- Facts and statistics collected together for reference or analysis.
  - The quantities, characters, or symbols on which operations are performed by a computer, which may be stored and transmitted in the form of electrical signals and recorded on magnetic, optical, or mechanical recording media.

– (Philosophy) Things known or assumed as facts, making the basis of reasoning or calculation.

We can establish that data is unprocessed values; they could be anything such as 2, 4, 590, 24, or 190. On their own they mean nothing. We turn them into information by organizing them through processing. In this small example of ours, let us say that these numbers were taken straight from sales and they represent the sales values as below:

January 10, 2019–Sales 2
January 15, 2019–Sales 4
January 18, 2019–Sales 590
January 25, 2019–Sales 24
February 5, 2019–Sales 190

As data and information, they are simply tools for making decisions. In order to turn them into knowledge and answer "how", we simply put these numbers as transactions into the ledgers. For the next step in our thinking process, we consider why our sales peaked on 18th January: for example, our company had a small exhibition downtown.

Up to this point our thinking process has brought us the data and then the information, which became knowledge and then understanding of this process. Our wisdom, then, is the experience that is acquired with time, and most of the time it is acquired through trial and error.

We would like to introduce the Accounting Information System at this point. This is the application of accounting using information technologies (Mark & Simkin, 2014). Having been around since computer technologies became a major part of business life, it is not new. James A. Hall put the Accounting Information System within the Information System of Businesses, as shown in Fig. 22.2 (Hall, 2012).

The main revolution for accounting brought about by the Accounting Information System was that it enabled non-financial data to go through the same process as financial data and to become information to turn into knowledge with which to make decisions.

It started with counting beads on an abacus, then calculators and on to computer systems. Today we talk about blockchain technology, which has had an impact on the accounting and auditing profession.

22.4 Blockchain, Bigdata, Cloud Systems

Many renowned academics and scientists have explained blockchain, big data and cloud systems. As accounting and audit academics who are also CPA and independent auditors, our coding knowledge is close to non-existence. We haven't attempted to learn any coding whatsoever for the sake of this study; however, we have

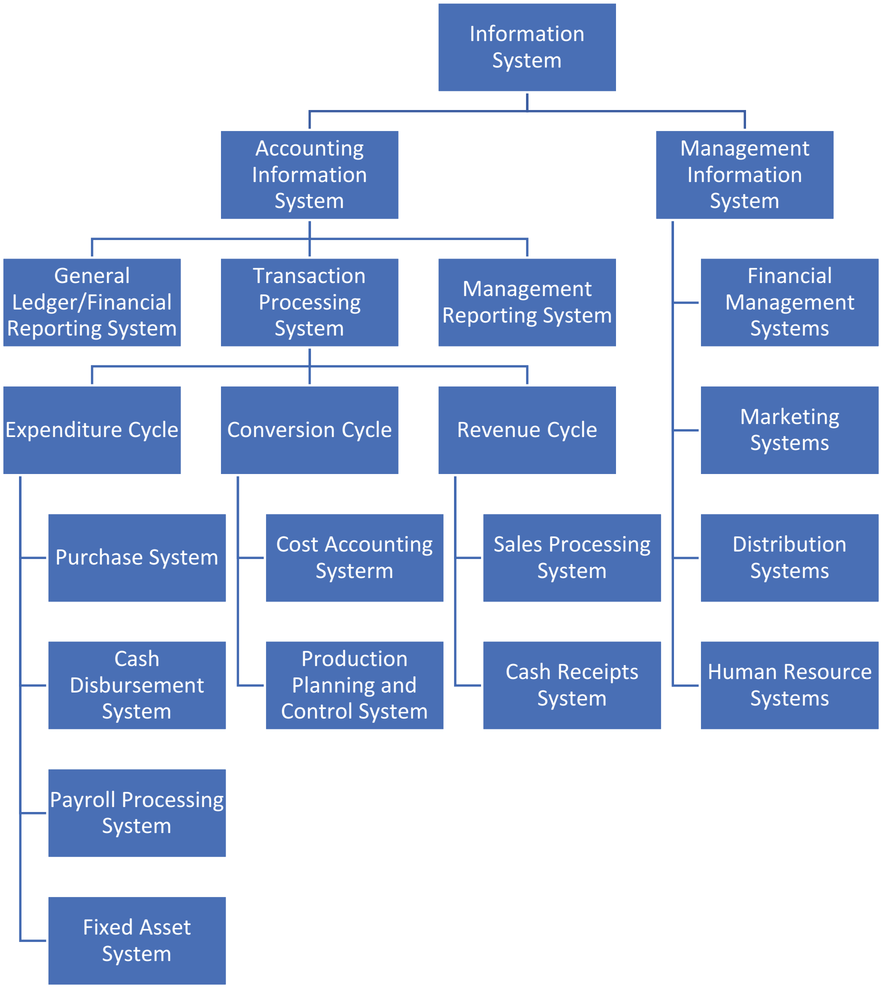

Fig. 22.2 A framework for information systems. Source: Hall, J. A. (2012). *Accounting Information Systems, 8e*. Cengage Learning: United States

processed bigdata, blockchain and cloud systems through our accounting and auditing perspective. As we explained in the previous section:

Using information technologies—scratch the "information"... Using technologies is not a new thing for accounting, it has done so since accounting has been around. In order to explain bigdata, we must establish Internet of Things, or IoT, which has became widely used in not only academic papers but also in the daily language. According to Karimi and Atkinson;

> Depending on who you talk to, the Internet of Things (IoT) is defined in different ways, and it encompasses many aspects of life—from connected homes and cities to connected cars and roads (yes, roads) to devices that track an individual's behaviour and use the data

collected for "push" services. Some mention one trillion Internet-connected devices by 2025 and define mobile phones as the "eyes and ears" of the applications connecting all of those connected "things." Depending on the context, others give examples that are less phone-centric, speak of a class of devices that do not exist today or point to Google's augmented-reality smart glasses as an indication of things to come (Karimi & Atkinson, 2013).

22.5 The Potential Impact of Blockchain on Fiscal Audits and the Audit Profession

This chapter aims to look at the links between information technology and the audit profession. Auditors have been users of computerized tools for many years, and the various accounting standard setters have included an element of information technology in their studies to ensure this requirement. However, most of these efforts have been mainly focused on the record keeping function, mainly hardware and software, rather than communication. If the collected data is reliable, it will be meaningful and useful. Blockchain serves up that data, provides access to that data, and provides the transparency to that data that fuels the analytics and machine learning (Drew, 2018). So with the new era in the business environment, using collected data for decision making lies in management's focus within the business strategy. Because of the speed of development, an external and backward-looking focus can no longer make only passing reference to information technology. Accounting information needs to be used as an internal and forward-looking approach.

Accounting is defined as the language of business in general, but is also argued to be both an art and a science. Despite the standards and regulations governing accounting measurement, the results are subject to the inherent inaccuracies of any measuring device. The science of accounting lies in the use of sophisticated techniques and logic analysis in the manipulation of accounting information for decision-making purposes. Although there are different perspectives on the issue, it's clear that science has been heavily influenced by information technology (Graham Jones, 1988). With the predominant increase of computers in all aspects of business life, accounting began to be applied to areas beyond its archiving and record-keeping function. Companies began to integrate their monetary and non-monetary activities with decision support systems under the title management information systems. The cycle of transforming inputs to outputs via the accounting process may involve thousands even millions of transactions, regardless of the complexity of the company.

Auditing, which is an essential tool that gives information users confidence and increases the reliability of fiscals, has an important effect on closing the existing expectation gap between auditor and stakeholders. Raw data is important because it marks the starting point of an audit trail—the path that data follows as it goes through the accounting information system (Mark & Simkin, 2014). Auditing involves inspecting the accounting information system, checking whether the financial reports present a fair and true view in accordance with established criteria and reporting their findings. In the past auditors placed a great deal of emphasis on checking detailed transactions all through the system and transforming it into reports. But as companies grew, it soon became nearly impossible and the system-based audit approach was built (Graham Jones, 1988).

22.5.1 What Are the Expected Changes in the Auditing Ecosystem?

This chapter provides a synthesis of the concerns facing audit professionals regarding the application of blockchain technology. It is hoped that this will contribute to the study of auditing by clarifying emerging concerns and building a path for future studies.

With the application of blockchain technology within the new business ecosystem, transaction costs will be dramatically reduced. While this can be applied to many sectors, the most important impact can be seen in financial services, for example, new types of audits and new types of IT audits will arise (Drew, 2018). Many companies have invested in this new digital platform in order to transform traditional practices to new business approaches. As a result many financial services companies, especially those in accounting and auditing, take into account this innovative approach. It's clear that with the widespread application of the blockchain system, there will be a new field for the profession within this new ecosystem, providing new assurance and audit services.

Distributed ledger technology has the potential to become a host for voting, registering digital assets, digital signing, and transmitting secure data. Since the data stored in distributed ledgers is authenticated by multiple parties and continually updated, it offers finance teams the possibility of both real-time reporting to management and external auditors, and being able to work more effectively with their external audit and tax providers (Tapscott, 2016).

Referred as the digital ledger, blockchain technology has a great influence on all recordkeeping processed in companies. Book keeping and tax services need to be updated according to these innovative changes, while at the same time, the audit approach urgently needs to be updated. With the widespread application of blockchain technology, new goals and approaches need to be set for both the accounting and auditing profession. Regulatory bodies need to create a new set of goals for auditing and assurance services, especially to build up an audit approach for this new world of real-time data management. The evolution of audit and assurance services regarding this new field, the auditors needs to execute all the audit work from a to z. The profession may evaluate from giving assurance to the reliability of a blockchain rather than auditing the fiscals.

Access to real-time information through blockchains may present a greater opportunity to apply audit analytics, though auditors will still need to assess the appropriateness of management's valuations, classifications, and recognitions, among other complex matters (Ortman, 2018).

A digital ledger sounds simple but blockchain creates significant changes in the input-process-output transformation of accounting. Instead of using printed documents as inputs, transactions will be collected among various parties on a network captured online. Companies in the chain will be a part of the shared database, which can obtain an identical copy of the transactions. The exchange of value between those in the chain is managed peer to peer with an algorithm. Consensus of the members among the nodes is needed to record a transaction. This predetermined mechanism sets the rules to check whether the transaction is valid or not. If it is accepted, it will be recorded on all the ledgers of the system in blocks linked with the previous blocks. The change of the transaction once it is accepted and stored in a block is nearly impossible to alter. So the process cycle has also changed tremendously. These changes in the characteristics of record keeping will surely be implemented in many industries in the near future.

The distributed nature of the system is the most significant change in the business environment. It gives the advantage of proving in a secure digital way when a transaction occurs. The transaction of value between parties also decentralizes from the traditional economic structures of the business ecosystem. Transferring values between parties without any intercessor catalyzes the process, and using a centralized processor, maintains an accurate, reliable and secure network.

22.5.2 How to Build the New Audit Approach?

Professional skepticism needs to be maintained while conducting an audit of a blockchain system. As it's a new way of record keeping in a digital environment, each blockchain system may have different characteristics that need to be taken into account. Auditors are not familiar with auditing fiscals over a centralized digital database connected over blocks of data. So it may bring lots of new risks totally different from the current audit system (Sadu, 2018). Without a doubt, the system will improve efficiency, and reduce operation times, costs and errors. But it will surely have specific deficiencies that may result in inherent risks. It is possible that near future audits will be finalized over the digital environment and won't require any field studies. However, new skills will probably need to be improved. Regulatory bodies need to adopt their standards and life time education programs to this developments, and auditors will need to be innovative regarding education.

The steady progress of automation will mean that, in the near future, it will take on the roles of intermediaries and the human workforce. The financial services market will be reconstructed. Auditing and assurance services will become services of increasing value. Keeping track of economic values, reporting and reconciling them with related parties is an indispensable part of the business ecosystem, but it also takes a lot of time and is subject to risk. Tracking the value transfer over a blockchain platform rather than just related parties' ledgers and documents will simplify many business processes that in today's digital environment are very cumbersome.

Auditing certainly increases confidence in financials. In order to enhance this confidence, auditors must become the assurance for the whole economic system. The quality of an audit is regulated by strict regulations and standards and a professional code of conduct for professionals, and this must be maintained. The profession will face a significant change in all its aspects over time. If all economic records are to be kept in an unalterable environment, do we really need an independent auditor's report of the decision-making process of all related parties?

It is possible that obtaining sufficient and appropriate audit evidence in a blockchain, even related to its environment, may still be unauthorized, fraudulent, or manipulated between related parties, or linked to a side agreement which is "off-chain", incorrectly classified in the financial statements (CPA Canada, AICPA, 2017).

Today's audit engagements may involve examination of clients' extremely large volumes of data sets that have the potential to be mined for information. All of these sets contain data that can be collected, analyzed and monetized (Appelbaum, Kogan, & Vasarhelyi, 2017). Computers allow users to make sense of increasingly large information in real time. So this large use of data could make privacy obsolete or bring transparency and accountability. It's obvious that data analytics has the advantage of speed, volume, variety and veracity, but what about the judgement? What will be the new function of the audit profession in this changing business environment? It's clear that there are lots of benefits of such technological developments; by analyzing big data, the users of this information can better understand the related parties, find opportunities, provide a better service and even mitigate fraud. The increasing volume and complexity of data opens up new opportunities for audit and assurance services to be even more valuable, relevant and responsive to the changing needs of stakeholders.

The security of blockchain lies in its peer-to-peer network, verifying digital identity and data authentication proof-of-work code, as previously described. But it has its own vulnerability. If the majority of users on the distributed ledgers become corrupt, the chain could be broken. Or programming mistakes may occur, as a Swiss-based DAO discovered when it lost US$50 million in virtual currency in June 2016 (Tapscott, 2016). It is best to remember that no matter how advanced this technology is, it requires a human to code the software. As long as there are humans, there will be fraud, and while there's fraud, auditors are needed to audit. Auditors are required to understand the specific risks to an entity's financial statements arising from IT, and how the entity responds to these risks through the implementation of IT controls (Psaila, 2017). Company controls over

- error handling,
- completeness and accuracy for applications extracting data from blockchain to be used in reporting,
- user provisioning for access to write to a blockchain,
- and cybersecurity

will be more critical for auditors. IT controls will gain a pivotal role in providing a reasonable assurance that financial statements as a whole are free from material mis-statement (Psaila, 2017). Also smart contracts, however embedded in the blockchain, will require auditing.

It may appear difficult for the auditor to collect evidence when working in a decentralized environment. But obtaining data from a blockchain network may also be challenging. One of the main concerns will be the reliability of the data, as it won't just be controlled by the audited client. Understanding the blockchain environment, including its digital technology, will be the touchstone for audit professionals, especially for small- and medium-sized practitioners. As with understanding and assessing risks of a regular company, risk assessment in the blockchain environment will begin with interrogating the reliability of the digital protocol itself.

Since information cannot be altered, leveraging the timestamp functionality and unique hash ID assigned to blocks of information provide audit professionals with a ready-made audit trail. The auditor needs to take into account that information stored on the blockchain is encrypted, and available to all network users who are a part of the audit process and already approved by a consensus protocol (Smith, 2018).

Far from recording historical data to accounts, with the practice of principle-based standards accounting, estimates now play an important role in the accounting and auditing cycle. With a simple example the auditor still needs to apply ISA 540 Auditing Accounting Estimates, Including Fair Value Accounting Estimates and Related Disclosure, while conducting the audit of a blockchain. The usefulness of the obtained data from a blockchain will be valid only if it's considered so in the auditor's professional judgement. The control and inherent risks of the data must be taken into account. In this case information technology audit services may come to the fore. What happens in a block in its algorithm must be expanded and must be inspected due care? It is essential for auditors to understand the accounting of crypto currencies and how the protocol works. There are several studies on virtual/digital currencies but regulatory bodies still have not set specific standards. The lack of standardized crypto currencies taxonomy will be one of the difficulties that practitioners will face. Evaluating management's policies for crypto currencies will be a further concern.

The audit profession, which enhances trust for company operations, will remain a powerful tool in ensuring the community's confidence in fiscal reports. The capabilities, effectiveness and professionalism of an auditor will remain the core qualities of professionals. Audit professionals need to reassess the procedures for tailoring the appropriate audit procedures according to the new risks faced in the digital environment. Even though the environment has changed, fraudsters will remain a constant. The auditors of today are used to electronic documentation and conducting their audit with or over computerized environments. The advantage of obtaining nearly real-time access to blocks of data from the chain may be useful for auditors to develop industry-specialized software to conduct continuous audits.

There are extraordinary challenges and opportunities facing the millennial generation of assurance professionals. It is probable that traditional auditing, review, attestation and other assurance services will remain necessary in many parts of the globe and in many traditional business environments. However, importantly, a new generation of millennial auditors will need to raise the bar by providing increasingly complex assurance services in more agile business environments and in support of upcoming digital transformations. The changing face of the business environment may divert professional services from assurance to non-assurance services. The intersection point will be management consulting services. The primary aim of assurance services is maintaining the quality of information: generating recommendations to a company will arise at this intersection point. A different professional audit mindset and additional expertise will be required to satisfy the expectations of stakeholders and business owners in this new untested ecosystem (Nikitin, 2017).

22.6 Conclusion

There are several reports on the expected benefits and coercive factors regarding how a business can use blockchain in assurance services. With the rising volume of companies being part of a chain, the rate of adopting audit work will increase. The expectation that blockchain technology will replace accounting and the auditing profession is misleading. As presented here, management assertions are an important part of the financial statements, which cannot be easily estimated in blockchains—they to be calculated with professional judgement. The whole audit needs to be conducted in a skeptical way, as any material mis-statements can undermine confidence in the statements. Also it is an auditor's responsibility to obtain reasonable assurance and to publish his/her opinion of the financial statements. It is clear that being a part of the chain will affect the clients' information technology infrastructure and the way they produce their reports. The responsibility of the audit profession from this perspective will be to increase the level of understanding of IT systems and the process of converting data into information. New risks need to be classified related to the sectors in which blockchains are applied. The confidentiality of the information will be another issue. In the near future, service providers will need to account for auditors tailoring his/her audit procedures in the blockchain. During this evolution in audit processes, auditors will need to bring together their experiences from conversational audit procedures and the enthusiasm of integrating IT systems into the audit, in order to overcome the problems of the evolution. The human mind will remain a key part of the process, but it will work together with technology one step ahead then mastering in excel.

The role of auditors in society does not end at providing an opinion on legality, accounting and compliance. Any individual or organization seeks accountability prior to engaging into a contract, and auditors build that trust by auditing control mechanisms, and spotting anomalies or unusual trends. But the audit procedure has remained relatively unchanged for decades by ignoring the inherent change of information from paper to digital (Spoke & Steele, 2015). Blockchain technology and smart contracts have the potential to make intermediaries like bankers or brokers absolute. And the audit profession will not be an exception unless assurance processes adapt to this technological shift (Psaila, 2017). The question is how. Sample-based audit procedures, asking for confirmation letters or bank statements, looking at payrolls, investigating invoices and questioning whether invoices are real, and fulfilling the terms, endless stock counts on cold days at the new year, will evolve into simply verifying transactions on publicly available blockchain ledgers.

It is not certain that blockchain will compromise the role of auditors in the financial system. But it is obvious that, as the accounting and auditing profession reflects the business ecosystem, blockchain will result in dramatic changes. The quality of an audit is constructed by the application of ISA's. With changes in the economic environment, the role of regulatory bodies should be monitoring and applying the digitalization of the business environment in compliance with auditing standards. The impact of blockchain technology on the accounting and auditing profession is as yet unknown, according to Mahbod and Hinton (2019), but one major effect clearly will be on sampling and audit planning, as the audit process will evolve into a continuous audit. In this case, the quality or the effectiveness of an audit comes at the point of understanding and applying data analytics.

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Chapter 23
Reflections of Digitalization on Accounting: The Effects of Industry 4.0 on Financial Statements and Financial Ratios

Melissa N. Cagle

Abstract Following the recent Industrial Revolution, Turkey has demonstrated a strong willingness to digitalize their operations and incorporate Industry 4.0 components under firms manufacturing processes. Quickly gaining the support of the Turkish government, the 4.0 movement has flourished and presented researchers with a unique opportunity to compare the pre-post implementation outcomes of the transition. Considering the current international literature on the acknowledged benefits of the Industry 4.0 movement and the inherent cost of incorporating new technology under the organization, managers are naturally expectant that their technological investments results in deserved payouts. Firms have been long motivated in evaluating the potential payback of their investments. However, previous research has faced difficulties when analyzing the relationship between productivity and information technologies. By employing use of the actualized Industry 4.0 benefits under organizations, this Chapter aims to provide an assessment of the implementation outcome of the digitalization process and provides an in-depth understanding of the financial impact of Industry 4.0.

23.1 Introduction

Industry 4.0 has dramatically changed the current business model and society at large (Dai, 2017). Defined as a transformational model aiming to increase the flexibility of the value chain by improving the transparency of all business functions (accounting, legal, human resources, production…etc.), the movement towards Industry 4.0 imposes new ideology/ways of thinking that will become the cornerstone of digital transformation of businesses at a global scale (Moraliyska & Antonova, 2017). As argued by Mai and Ninh (2017), the fourth Industrial Revolution contains the potential to affect entire industries by transforming the way goods

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are "designed, manufactured, delivered, and paid". The main characteristic of Industry 4.0 is the movements ability to impact/transform the physical/virtual reality via combining "real-time data processing with interconnected machines/devices, artificial intelligence, humans, and complex solutions" (Moraliyska & Antonova, 2017).

Following the 2011 movement, the old approaches to value creation are no longer suitable for tackling issues such as "cost efficiency, flexibility, adaptability, stability, and sustainability" (Mai & Ninh, 2017). Not only has this digitalization movement imposed new requirements on the manufacturing industry, but it also has opened up the channels for rapid technological processes and in turn, created new business potentials/opportunities. With the popularization of Industry 4.0 (Emrich, Klein, Frey, Fettke, & Loos, 2018) across a wide range of countries, companies are now facing increased pressure by their national governments to take part in the transition.

Several highly publicized examples could be listed as follows. The EU efforts to promote Industry 4.0 with "For a European Industry Renaissance", the 2012 "Industrial Policy", and the Turkish efforts with the "2017 Project-Based Incentive System" published by the European Commission and Turkish Government, respectively. Today, Industry 4.0 promises to play a major role in creating new jobs and providing the most up-to-date goods/services to consumers.

Considering the acknowledged benefits of the Industry 4.0 movement and the inherent cost of incorporating new technology under the organization, managers are naturally expectant that their information technology investments results in deserved payouts. Firms have been long motivated in evaluating the potential payback of their investments. However previous research has faced difficulties when analyzing the relationship between productivity and information technologies (Tang, Huang, & Wang, 2018). There is a clear gap of research on detailed classification of Industry 4.0 activities (Emrich et al., 2018). Thus, the more empirical research that is conducted within this area of study, the better the overall relationship between these technologies and the actualized Industry 4.0 benefits can be understood.

In order to measure the impact of Industry 4.0 practices, an empirical analysis evaluating the financial performance of the current digitalization movement will be conducted. By employing use of the actualized Industry 4.0 benefits under organizations, this Chapter aims to provide an assessment of the implementation outcome of the digitalization process and provides an in-depth understanding of the financial impact of Industry 4.0. As recognized by Emrich et al. (2018), there is further need for research in this area as the authors call for an analysis to be conducted on financial ratios and business models.

This Chapter offers a novel contribution to the Industry 4.0 literature as it analyzes the actualized benefits identified by manufacturing firms after their digitalized transition. Stated differently, the chapter will employ use of the actual Industry 4.0 transition benefits/outcomes as recognized by the firms themselves vs. using factors under the analysis that was either (1) not intended by the organization, (2) not achieved at the end of their 4.0 efforts. It is important to distinguish between literature supported benefits of Industry 4.0 and the actualized benefits of 4.0 as attempting to measure the former would lead to inconsistent results. By focusing on the actualized benefit of Industry 4.0, this Chapter provides more concrete insight for managers, researchers and potential firms hoping to transition towards Industry 4.0.

This chapter is structured as follows. Section 23.2 will provide supportive literature and address the main ideas and concepts behind the Industry 4.0 transition process, highlight the main motivating benefits behind the transition and explore the current empirical studies. Section 23.3 will present, in detail, the research design, while Sect. 23.4 lists and discusses the findings of the empirical analysis. Finally, Sect. 23.5 will address the limitations and future directions of this area and conclude.

23.2 Literature Review

This section aims to shed light on the current global and local ecosystem that is pushing for the fast implementation of Industry 4.0. Overall, the (1) economic impact of the digitalization process under businesses (Moraliyska & Antonova, 2017), (2) inherent difficulty in evaluating the value generated by the implementation of these new digitalized technologies and (3) level of uncertainty within transitioning firms/industries are determining factors affecting the speed of the Industry 4.0 transition (Sommer, 2015). By providing a critical assessment of the related literature and international efforts, this section hopes to emphasize the idea and processes behind the formation of the new technological/organizational changes under firms.

23.2.1 The International and National Movement Towards Industry 4.0

23.2.1.1 The EU Perspective of Industry 4.0

The Industry 4.0 movement currently targets a wide range of countries (European Commission, 2017), including major players like Spain, UK, France, Italy, Germany, Sweden and the Netherlands. However, with less than 50% of European Union (European Commission, 2017) businesses adopting digital technologies, coupled with the fact that Industry 4.0 could be considered a competitive advantage-governments are now preparing their own legal frameworks to aid transitioning firms. Most importantly, governments are putting aside public/private funds for support of this digitalization process. Thus, firms are motivated to act more quickly in order to get ahead of the movement and take on market share.

Recognizing the need to focus on growth and jobs in the "post crisis" era, the European Commission called for its Member States to focus on their manufacturing industries. In 2014, the European Commission adopted the "For a European Industrial Renaissance" (COM(2014)14/2) with the aim of "increasing and sustaining industrial competitiveness within the European economy, overseeing the implementation of policies that would support innovation/skills/entrepreneurship, encourage investment levels and integrate European firms within global value chains". Following the communications adoption, the Commission published a road map outlining the steps for a "EU industrial policy" (EC, 2014). In the year 2012, the European Commission published the "Stronger European Industry for Growth and Economic Recovery" (COM(2012)582) communication (EC, 2012). This communication called for a joint partnership between Member States and the industry, focusing on "increasing innovation investments, providing funding and improving market conditions". Moreover, the communication ensured that small and medium-sized enterprises would be prioritized within these efforts.

Upon individually analyzing the European Member States current Industry 4.0 transition activities, it is apparent that most have made the digitalization movement "top priority". However, despite the fact that the Member States provide a united front in this regard, they differ in policy, funding approaches and strategies. Information on this can be found under the "Key Lessons from National Industry 4.0 Policy Initiatives in Europe" report published by the European Commission in 2017. According to the report, only eight of the current 28 EU Members have presented funding approaches targeting a variety of organizations, such as; small and medium-size enterprises, large companies, manufacturing firms, general businesses and even, service sector companies. These types of organizations are granted mixed/public funding opportunities with budgets ranging from 25 million euros to 10 billion euros. Countries with the highest budget awarded by EU governments are as follows; France, Germany, UK and Spain (EC, 2017).

The publication of a budget and the target audience for Industry 4.0 transitioning firms demonstrates that these countries have embraced the digitalization movement. The motivation for these countries are identified by the European Commission and can be listed as follows; "industry demand, collaborating agencies, national authority decisions and publicly available funding opportunities" (EC, 2017). However, these countries face several barriers to implementing Industry 4.0 policies. The need to "balance competing interests, diverse competencies, multiple stakeholders, a general lack of capacity and funding". As such, the involvement of regulatory agencies and cross-country coordination between Member States are imperative in order to ensure the speed of Industry 4.0 transition is not reduced and any remaining uncertainty is resolved. The structure and support available for firms and countries is an important factor driving EU transition. Thus, it is not surprising that these countries are currently leading the new Industrial Revolution.

23.2.1.2 The Turkish Perspective of Industry 4.0

Not unlike the global players of the Industry 4.0 movement, Turkey has set aside a large budget to aid in the national transition efforts of manufacturing firms. The "2017 Project-Based Incentive System" launched by the Turkish government demonstrated the countries commitment toward transitioning towards Industry 4.0, higher employment levels and improved export activities (Sanayi Gazetesi, 2018).

The system granted approval for 23 projects with a total cost of 135 billion TL and aims to increase this number in the following years. It argues that these efforts and incorporated technological advances will increase the competitiveness of Turkey, while reducing the trade deficit. Finally, the system also supports vital operational functions such as “energy, capital contribution, wireless investment, allocation and employment protection”.

A similar project undertaken by the Turkish government targets the activities of small and medium sized enterprises (SMEs). While large and medium sized enterprises adapt to the new technological requirements with ease (a benefit of their size and resource accessibility), it is imperative that SMEs are not left behind in the Industry 4.0 transformation race. In order to ensure this does not happen, the Turkish government granted the necessary support though the TUBITAK (Scientific and Technological Research Council of Turkey) and KOSGEB (Small and Medium Enterprises Development Organization). These development agencies granted a budget of 500 Million TL, as announced by KOSGEB (Kosgeb, 2018). The program allows for businesses to receive a support for 60% of investment costs. The aim of the program is to ensure that SMEs are furnished with new networks, hardware, software systems, smart sensors, mobile applications and mobile end-user devices, and are digitally transformed into adaptable businesses. These efforts and the Turkish governments promise to increasing the rate of accepted 4.0 projects in the following years is an important indicator of the countries commitment.

23.2.2 The Motivating Benefits of Industry 4.0 Implementation Under Businesses

As supported by Emrich et al. (2018) the current digitalization process overtaking businesses has become increasingly complicated to the point that keeping track of these new technologies is difficult. However, there is a wide list of general benefits (Ferreira, 2017) involved in transitioning towards Industry 4.0, and this issue has been covered in extensive detail under the literature. Whether the movement is successful in increasing corporate profitability, competitive advantage, the quality of produced products, affecting the business models, updating data processing activities, improving safety and health conditions—or not, Industry 4.0 promises to affect small to large companies equally (Emrich et al., 2018). The Industry 4.0 literature argues for the following benefits.

Schlogl and Sumner (2018) addresses the “optimism camp” under their study and proposes that even though losses might be suffered initially, it is temporary and will ultimately result in the automation and digitalization movement taking over “repetitive/dangerous/unhealthy tasks and improving quality of work/products”. Shiller (2017) argues that the movement will result in “undeniable productivity growth”, while Pagalday, Zubizarreta, Uribetxebarria, Erguido, and Castellano (2018) states that it will increase the competitive advantage of firms. Moreover, Erdoğdu and

Karaca (2017), Vishnevsky and Chekina (2018) supports that the technological advances will increase corporate profitability (Atkinson, 2018; Bell, Bristow, & Martin, 2017; Ferreira, 2017; Mazur, 2018), even ensuring that society benefits from these shared earnings. Thus, it is not only the corporate owners that will be benefiting from this transition, but also society as a whole. By distributing the corporate earnings, either in the form of a robot tax or increased employment opportunities by newly generated services (Apostolopoulos, 2018), citizens stand to benefit from the Industry 4.0 movement, despite the initial costs.

The Industry 4.0 movement also promises to have benefiting effects on real time data processing activities, as well. For example, according to Gupta, Keen, Shah, Verdier, and Walutowy (2017) one of the many notable benefits of the revolution is the potential for collecting/processing/disseminating information in a timely/easily accessible/transparent manner. The authors argue that the improved storage capacity/processing power allows for collecting and tracking more information, while interconnected systems enable cross-departmental communication and planning. Delvaux (2017) on the other hand, argues that these developments will transform and enhance the level of services and work practices (transportation, education and training) by increasing efficiency. These could also ensure that cost saving is achieved (Emrich et al., 2018; Mai & Ninh, 2017; Nandajan & Trainer, 2017). Moreover, the authors argues that automation activities will reduce labor costs while simultaneously resulting in increased productivity levels with "less errors, higher quality output and greater speed". Moraliyska and Antonova (2017) recognizes that the firms transition towards Industry 4.0 will allow for a faster response to market changes and rapid prototyping. These increasing innovative applications (design/manufacturing) (Moraliyska & Antonova, 2017) can also have the benefit of allowing for faster identification of machine faults and increased communication between suppliers/customers/departments (Dai, 2017). This translates into increasingly reliable and consistent/quality production (Apostolopoulos, 2018) under the manufacturing process, better decision making opportunities with increased data availability (Ferreira, 2017).

Another benefit addressed under the Industry 4.0 literature is the increases in workers health/safety conditions (Ferreira, 2017; Toensmeier, 2018). By taking over the potentially hazardous jobs, robots can insulate workers from harmful exposure. Additionally, these robots are able to continuously operate at designated speed and accuracy, while producing quality and productive outputs (Toensmeier, 2018). Finally, the Industry 4.0 literature argues that the transition could even positively affect firms business models (Emrich et al., 2018; Mai & Ninh, 2017), increase market share control for supply chains (Ferreira, 2017), allow for accurate risk assessment (Mai & Ninh, 2017), result in higher mobility, improve the skill-set of workers (Yamashige, Yamashige, & Kawakami, 2017) and even improve the managers skill level for solution building (Nandajan & Trainer, 2017). Considering the numerous benefits addressed above, it is not surprising that there is an increase of firms joining the Industry 4.0 movement in trying to digitalize their operations.

23.2.3 Empirical Research Concerning Industry 4.0 Outcomes

Despite the professed benefits of Industry 4.0, the empirical literature analyzing the outcomes of this investment are currently limited. A review of the relevant literature reflects the relationship between previously conducted empirical research and the effects of the digitalization movement on firms. Corò, Pejcic, and Volpe (2017) analyzes the effects of technological adoptions in relationship to the Industry 4.0 movement. With a sample consisting of manufacturing, construction and business firms, the paper supports the heterogeneous distribution of digitalization technologies across sectors. Restricting their sample based on the number of workers employed and minimum production value, the paper divided the respondents by sector and searched for the existence of digital technologies, such as; Internet of Things, 3-D printing, big data, etc. The study also took into consideration the organizations alternative market accessibility, workers skill level, production/productivity and financial performance. They determined that firms that employ use of digital technologies have higher productivity levels in comparison to those that do not, and have a more balanced financial structure. However, the results regarding their financial performances were ambiguous, and the firms employing use of digital technologies did not show a trend of being more profitable.

Tang et al. (2018) analyzes the implementational impact of Internet of Things applying firms. Collecting data for the period between 2010 and 2015, the authors conducted a performance analysis on the Fortune 500 companies employing use of the following ratios; "asset turnover, accounts receivable turnover, labor productivity, inventory turnover, return on assets, return on equity, profit margin and debt to equity". In order to determine which firms apply Internet of Things, the authors collected information from news reports. The results of the analysis suggests that the application of Internet of Things generate a positive impact on the firm. The paper determines that adopters have higher return on assets ratios, market value and productivity performance than those that do not. Moreover, they argue that first movers are more attentive to Internet of Things investments, are in a more advantageous position and are better able to allocate resources and labor. Offering a comparative analysis of manufacturing and service sector organizations, Sabherwal and Jeyaraj (2015) conducted an analysis on the business value of information technology in consideration of firm profitability and productivity. The authors extend the scope of a meta analysis and determined that business value increases when analysis do not consider IT investments and profitability measures. On the other hand, they also determined that technology adoption and usage increase the strength of the relationship between IT investments and business value. Finally, productivity measures are found to be ineffective on business value.

Analyzing the overall value generated by Industry 4.0 activities under Hungarian firms, Nagy, Oláh, Erdei, Máté, and Popp (2018) collect information regarding logistic services, efficiency processes, partners, market success and financial indicators and their competitiveness level. Conducting a survey on manufacturing firms employing use of various technologies, the authors cross-referenced the data with performance indicators. They determined that logistic firms are more efficient in employing these technologies and have higher profitability levels. When using big data, these firms have higher levels of competitiveness. Identified factors blocking firms from transitioning towards Industry 4.0 are listed as follows; “unknown costs, lack of standards/norms/certificates available ensuring interconnection of systems, organizational resistance and management support”. Data and Hoab (2017) conduct an analysis on performance in order to determine firm level factors affecting technology adoption. Employing use of “return on equity, total assets, revenue (log), R&D expenses, current ratio, leverage, tangible assets”—the authors run a regression analysis and determine that return on equity is positively related with firm size and growth. On the other hand, current ratio, leverage, tangibility are found to be negatively related.

23.3 Research Methodology

This Chapter consists of a comparative empirical analysis of secondary data located within the publicly available annual financial statements of Industry 4.0 ‘transitioning” and “non-‘transitioning” BIST listed firms. The analysis focused on the outcomes of “actualized” benefits of the Industry 4.0 movement under manufacturing firms. The research design is presented in detail below.

23.3.1 Aim of Study, Motivation and Hypothesis Development

Coupled with the widespread recognition and usage of Industry 4.0, this study argues that there is great benefit to be achieved (Corò et al., 2017; Tang et al., 2018) from the digitalization movement and that the 4.0 transitioning firms will show greater performance under their financial ratios, compared to non-transitioning firms. Ultimately, new initiatives (such as the implementation of Industry 4.0) are the result of significant investments (Pagalday et al., 2018), and these undertaken activities exceed single digit cost-saving (Nandajan & Trainer, 2017). Thus, considering the high cost associated with such a transition, managers must be able to weigh the drawbacks/benefits associated with the innovated investments.

However, despite the recognized importance and current popularization of the Industry 4.0 integration under firms—studies analyzing the empirical transition benefits are quite limited. This limitation is partially because previous studies have faced difficulties when analyzing the relationship between productivity/information technologies (Tang et al., 2018), not only because of the (1) difficulty in pinpointing the event date (Industry 4.0 transition) under firms but also (2) theoretically matching the measuring variables and the analyzed outcomes. The research design employed under this chapter takes into account both issues.

Reflecting a general scholarly confusion about expectations, effects and evaluation—the mismatch of variables argument states that "the theoretical relationship should be explained clearly and comprehensive/valid measures should be employed under an analysis" (Wood & Jones, 1995) otherwise it will produces ambiguous results. Stated differently, the lack of consistency between employed theory and methods lead to "in-congruent and disappointingly thin results" (Wood & Jones, 1995). By focusing on the annual activity reports of listed manufacturing firms, the initial transition dates are identified. Moreover, the theoretical mismatch behind ratio research is addressed by employing use of the actualized Industry 4.0 benefits (the benefits manufacturing firms claim to have received as a direct result of implementing 4.0 activities under their operations). The usage of actualized benefits is a novel concepts that distinguishes this study from the current literature. Overall, improving the reliability of the ratios employed under the comparative analysis.

Finally, Emrich et al. (2018) argues that there is further need for research in this area and calls for an analysis to be conducted on financial ratios. In order to fill the current void within the digitalization literature, this study provides an empirical analysis of the benefits of Industry 4.0 implementation outcomes. This is important for highlighting the better performance of the digitalization process.

Moreover, as a developing EU candidate country, and the governments current commitment towards the Industry 4.0 movement (available funding opportunities, budgets location and strategic plans), the sample of Turkey presents researchers with a unique opportunity for analyzing/generalizing the outcomes of the transition and offers promise regarding the international literature contribution. Based on the previously addressed literature, the following hypothesis is presented under the study.

H1 The Industry 4.0 movement in Turkey has positively affected the operations of implementing BIST listed manufacturing firms.

23.3.2 Sample Selection

The period of data collection covered the years 2011 to 2017. The reason the initial analysis was restricted by the year 2011 is because the widespread publicization of the term "Industry 4.0" dates back to 2011. Moreover, the final year for data collection was restricted with 2017, as the latest published annual activity report by listed organizations is for that year.

The sample consisted of manufacturing firms listed under BIST. These firms were included under the analysis since, as argued by Nagy et al. (2018), the digitalization movement promises to have a wide effect on the manufacturing industry. Moreover, these firms are motivated to consistently evolve their production processes to keep up with the changing demands of customers and have chosen to embrace Industry 4.0 via incorporating complex technologies. Thus, the manufacturing sector would be ideal for analyzing the effect of this movement. Firms listed under BIST were included as the analysis requires access to annual activity reports (for categorization of firms) and publicly available information under financial statements. Moreover, listed firms are better equipped to finance the high cost of the transition (Nandajan & Trainer, 2017).

The sample of firms that were to be categorized as" transitioning" were selected using the following steps. Under the initial search, firms listed on the Turkish public disclosure platform official website (KAP) as being active within BIST in the year 2017 were determined. Out of the 516 companies listed within BIST, only 178 manufacturing sector firms were active.

Following this, the 2011–2017 annual activity reports of the initially identified manufacturing firms were subjected to a content analysis in order to determine their transitioning/non-transitioning status and year. For example, firms applying Industry 4.0 activities under their operation are categorized as "transitioning". The initial transition year was also determined (e.g. t = 2015). The firms annual activity report was employed as a source document under this step. As the publication of the annual reports are compulsory and allow for comparability and the information provided under these reports are a clear reflection of the intentions of the management (serving as an advertisement/communication tool) (Stanton & Stanton, 2002)—these documents were ideal for not only providing accurate information on the current digitalization activities of the firms, but also allowed systematically separating the sample group in preparation for the data collection process.

In order to determine the sample of firms to be included under the analysis, the source documents were searched via specific keywords demoting usage of Industry 4.0. These keywords consisted of the following items; "industry", "Industry 4.0", "digitalization", "[firm name] 4.0" and "internet of things". The search was conducted on the 2017 BIST listed firms, as mentioned above.

Upon conducting the search, 21 BIST listed manufacturing firms were identified as transitioning (157 non-transitioning) towards Industry 4.0 from the information provided under their annual activities reports. As the analysis is considered to be an event study, it focuses on the 3-year period around the application of Industry 4.0 activities. After determining the beginning implementation year for Industry 4.0 activities under the firm, the annual financial statements consisting of "1 year before implementation", "1 year after implementation" and "the implementation year" were downloaded (3 years worth of financial statements for each firm analyzed, more if available). Thus, the pre-post period reports were analyzed in order to provide a clear comparative evaluation of the event. The 21 firms identified under the initial search are listed under the following sectors, as specified under the Public Disclosure Platform (KAP). These firms sub-sector classification are provided under Table 23.1.

With nine listed within the metal goods, machinery and equipment industry, it represents the highest percentage (42%) of firms under the sample. The chemicals, petroleum rubber and plastic products sub-sector (24%) and the food, beverage and tobacco sub-sector (14%) are the second and third groups, respectively. Three industries were removed from the sample list of non-transitioning firms (34 firms across 3 industries), as these sub-industries did not have Industry 4.0 "transitioning"

Table 23.1 List of sample sub-sectors

Manufacturing sub-sector	#
Weaving, Clothing and Leather	1
Food, Beverage and Tobacco	3
Chemicals, Petroleum Rubber and Plastic Products	5
Metal Goods, Machinery and Equipment	9
Forest Products and Furniture	1
Stone and Soil Based Products	2

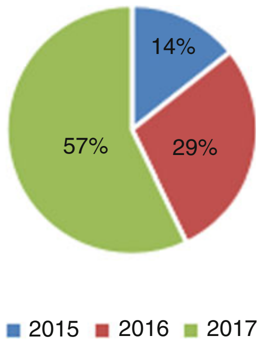

Fig. 23.1 Event date percentage

firms to compare against. Thus, the sample is finalized with 6 sectors, 144 non-transitioning and 21 transitioning firms.

23.3.3 Data Collection Process and Analysis

Firms were categorized as "transitioning" and "non-transitioning", separated according to the "Industry 4.0" elements provided under their annual activity reports. These firms were further separated according to their Industry 4.0 implementation date (e.g. t = 2015, 2016 or 2017). An issue of importance under such event research is the difficulty in determining when the analyzed effect (in this case: the implementation of Industry 4.0 activities under the business) takes place (Tang et al., 2018). Stated differently in order to achieve representative results, it is imperative to first identify the time of reference (the information technology investment) in order to determine when to measure for the outcome. This categorization was accomplished by taking into account the initial application date of the firms Industry 4.0 activities. Depending on the first mention date under the annual activity reports, firms were coded as "1" and "0" for non-transitioning firms. A list of the number of firms and their event date (Industry 4.0 implementation dates) are provided below under Fig. 23.1.

According to the information provided under Fig. 23.1, the most prominent start for Industry 4.0 activities were in the year 2017 (57%). The firms classified as "transitioning" were compared against the results gained from analyzing "non-transitioning" firms under the control group. These firms were included under the analysis in order to account for wide-sector effect encompassing the whole of the firms for that given time period and to highlight the different factors between the two groups (transitioning and non-transitioning). Moreover, the comparison of these two groups allowed for determining whether or not implemented Industry 4.0 activities were the motivating factor for the higher/lower performance.

In order to ensure that the "actualized" Industry 4.0 benefits were employed under the study (as mentioned above), the output items from Cagle, Dogru, and Yilmaz (2018) were taken as a base. Out of 76 of the identified benefits, 23 were suitable for financial measurement. The measures selected for the final evaluation are provided under Table 23.2. Two ratios identified under the following table were not calculated because of a lack of data; the scrap rate ratio and the return on investment ratio. Finally, the data was hand-collected from the annual financial reports (balance sheets, income statements, cash flow statements and disclosures) of listed manufacturing firms. Moreover the closing stock prices were hand-collected from the "big-para" website (http://bigpara.hurriyet.com.tr/borsa/hisse-fiyatlari/). However when compiling the data for 2018 the deferred quarter financial statements were downloaded, as the annual reports were not an available at the date of the analysis.

23.4 Discussion and Findings

The results of the discussion is presented as follows. As mentioned in Sect. 23.3.2, the initial Industry 4.0 transition years were determined for the sample. Depending on the identified transition year, the firm was categorized into 3 groups; those with a transition year of 2015 (t = 2015), a transition year of 2016 (t = 2016) and finally, a transition year of 2017 (t = 2017). Each analysis is re-calculated for the groups and the discussion is presented with that categories in mind. The reason the analysis was calculated without combining the whole sample is because the level of Industry 4.0 transition (beginning to intermediate) could influence the results of the analysis.

One of the first actualized benefits proposed by Industry 4.0 transitioning firms under their annual reports was "achieving operational excellence" [1]. In order to measure the benefit, the following ratios were employed; operating cycle (cash conversion cycle), fixed asset turnover and revenue per employee. The cash conversion cycle (CCC) provides information on how long the firms investment is secured within the production, before finally being turned into cash. Operational excellence is one of the main factors that manufacturing companies are continuously striving for. Thus, reducing the time it takes to (1) produce inventories, (2) sell the finished goods (3) collect the cash owed from customers and (4) to begin the production anew—is a process that firms will deal with as long as they are in operation. Upon analyzing the t = 2015 transitioning firms under Table 23.3, it is determined that, although the overall cash conversion cycle increases by 16% directly after the implementation, CCC is consistently reduced by 25% and 26% within the next

Table 23.2 Industry 4.0 actualized benefit and measurement

	Actualized benefit	Measurement	Formula employed
1	Reaching Operational Excellence	(1) Cash Conversion Cycle (Operating Cycle), (2) Employee Productivity Ratio, (3) Fixed Asset Turnover	*Cash Conversion Cycle (Operating Cycle)*: [(Average Inventories/(Cost of Goods Sold/365)) + (Average Accounts Receivable/(Revenue/365)) − (Average Accounts Payable/(Cost of Goods Sold/365))]
			Employee Productivity Ratio: Pre Tax Income/Number of Employees
			Fixed Asset Turnover: Net Sales/Average Fixed Assets
2	Enhancing Error Detection	Scrap Rate Ratio	*Scrap Rate Ratio*: (Number of Units Scrapped/Total Number of Units Produced) × 100
3	Improving Maintenance Activities	Maintenance Ratio	*Maintenance Ratio*: (Repair Expenses + Maintenance Expenses)/Total Fixed Assets
4	Improving Production Line Efficiency	Inventory Turnover Ratio	*Inventory Turnover Ratio*: Cost of Goods Sold/Average Inventory
5	Production Capacity Improvement	Fixed Asset Turnover	*Fixed Asset Turnover*: Net Sales/Average Fixed Assets
6	Improving Stakeholder Relations	(1) Market Value Added	*Market Value Added*: [(Notes Payable + Current Portion of Long Term Debt + Long Term Debt) + (Current Stock Price × Total Outstanding Shares)] – [(Notes Payable + Current Portion of Long Term Debt + Long Term Debt) + (Total Assets – Total Liabilities)]
7	Conducting Digital Planning/Innovation/Tech Infrastructure	R&D ratio	*R&D Ratio*: R&D Expenditures/Total Assets
8	Improving Workforce Efficiency	Employee Productivity Ratio	*Employee Productivity Ratio*: Pre Tax Income/Number of Employees
9	Achieving Inventory Optimization	(1) Inventory Turnover Ratio, (2) Stock to Sales Ratio	*Inventory Turnover Ratio*: Cost of Goods Sold/Average Inventory
			Stock to Sales Ratio: Net Sales/Average Inventory
10	Achieving Expense Efficiency	Overhead Ratio	*Overhead Ratio*: Operating Expenses/(Taxable Interest Income + Operating Income)

(continued)

Table 23.2 (continued)

	Actualized benefit	Measurement	Formula employed
11	Achieving Logistics Efficiency	(1) Inventory Turnover Ratio, (2) Accounts Payable Turnover, (3) Accounts Receivable Turnover	*Inventory Turnover Ratio*: Cost of Goods Sold/Average Inventory
			Accounts Payable Turnover: Total Supplier Purchases/Average Accounts Payable
			Accounts Receivable Turnover: Net Annual Credit Sales/Average Accounts Receivable
12	Improving Profitability	(1) Return On Assets, (2) Return On Equity, (3) Profit Margin, (4) EBITDA	*Return On Assets*: Net Income/Total Assets
			Return On Equity: Net Income/Average Shareholders' Equity
			Net Profit Margin: (Net Income/Revenue) × 100
			EBITDA: Operating Income + (Depreciation + Amortization)
13	Achieving Investment Efficiency	Return On Investment	*Return On Investment*: (Net Profit/Cost of Investment) × 100
14	Achieving Sustainable Growth	Sustainable Growth Ratio	*Sustainable Growth Ratio*: [Net Income/Average Shareholders' Equity] × [1 – (Total Amount of Dividends Paid Out to Shareholders/Net Income)]
15	Reaching Alternative Markets	Global Sales Ratio	*Global Sales Ratio*: International Sales/Gross Sales

2 years. The reducing conversion cycle indicates that the firms cash is tied up for less time, compared to the CCC result for the years 2014 and 2015. This results can be further supported by analyzing the t = 2015 transitioning firms accounts receivable turnover and inventory turnover. An analysis of the t = 2015 transitioning firms accounts receivable turnover indicates that the collection cycle remains unchanged for the receivable. The speed of collection slows down for the year 2015 by 13%. The following 2 years for the t = 2015 group indicates nearly no change (0.008 and 0.011) for the accounts receivable turnover. This result is also supported under the inventory turnover, as well. The ratio increases by 7% and 2% the following 2 years after the implementation of Industry 4.0 activities, however decreases by 42% by 2018. This indicates that the results gained from the CCC is not reduced by faster cash collection policies, nor a faster cycle of inventory. As a slower inventory turnover rate generally increases the cash conversion cycle, it is safe to assume that the production within the operating cycle could be related with the increased speed of production. This reflects the claims of Industry 4.0 transitioning firms that their production operations have become more efficient. As the operating cycle reduces, these firms are able to collect cash more quickly. The firms cash is freed

Table 23.3 Changes within transitioning firms ($t = 2015$)

		t = 2015			
		2014–2015	2015–2016	2016–2017	2017–2018
Profitability [12]	EBITDA	0.1919	−0.0007	0.0449	0.7136
Workforce Efficiency [8], Operational Excellence [1]	Employee Productivity Ratio	−0.0675	−0.1469	−0.1606	0.1586
Employee Number Changes	–	0.0088	−0.0051	0.0429	0.0380
Sustainable Growth [14]	Sustainable Growth Ratio	−0.4769	0.0830	0.5038	0.4537
Operational Excellence [1], Production Capacity Improvement [5]	Fixed Asset Turnover	0.0441	−0.6776	1.6256	−0.3321
Alternative Markets [15]	Global sales ratio	−0.0222	−0.5938	1.2676	0.2976
Logistics Efficiency [11], Inventory Optimization [9], Production Line Efficiency [4]	Inventory Turnover Ratio	0.0398	0.0650	0.0186	−0.4200
Inventory Turnover Per Days	–	0.0481	0.0079	−0.1174	0.6950
Digital Planning/ Innovation [7]	R&D Ratio	−0.1867	−0.0519	−0.1629	−0.3990
Profitability [12]	Return on Assets	−0.1023	−0.0278	−0.3130	−0.1517
Profitability [12]	Return on Equity	−0.0249	0.0661	−0.2268	−0.0637
Stakeholder Relations [6]	Market Value Added	2.8233	−0.7956	0.1843	−0.2180
Market Value Added Per Stock	–	−0.1255	−0.0415	−0.0322	−0.2339
Maintenance Activities [3]	Maintenance Ratio	−0.1519	−0.1057	−0.2778	−0.3986
Inventory Optimization [9]	Stock to Sales Ratio	0.0535	−0.7669	2.2544	−0.1302
Profitability [12]	Net Profit Margin	0.0124	−0.0553	−0.2784	0.3051
Stock Price Changes	–	−0.1001	0.0115	−0.0053	−0.0422
Maintenance Activities [3]	Maintenance Ratio	0.0275	0.1846	0.0597	−0.2457
Logistics Efficiency [11]	Accounts Receivable Turnover	0.0603	−0.1302	−0.0085	−0.0114
Logistics Efficiency [11]	Accounts Payable Turnover	0.0200	−0.0883	0.1674	−0.0091
Operational Excellence [1]	Operating Cycle (Cash Conversion Cycle)	0.0990	0.1590	−0.2503	−0.2690
Expense Efficiency [10]	Overhead Ratio	0.0066	0.2657	0.0307	−0.5187
Digital Planning/ Innovation [7]	R&D Expense Changes	0.0905	0.1841	0.2225	−0.0787

up for new investments in equipment and infrastructure, allowing them to further their investments and increase their returns. Contrarily to the results found under the t = 2015 transitioning firms, the t = 2016 and t = 2017 firms show an increase within their cash conversion cycle. This indicates that it takes longer for these firms to convert the production into cash. Thus, although the t = 2015 firms indicate that they have improved their operation activities, this result is not reflected under the t = 2016 and t = 2017 firms.

The second ratio employed in order to analyze the firms operational excellence [1] was the fixed asset turnover ratio. This ratio provides information on one of the largest investments within firms, highlighting its importance when analyzing the operational excellence of an organization. After investing in new fixed assets, this ratio allows for determining whether or not there has been a substantial improvement as a results of that purchase. Moreover, this ratio allows for analyzing how efficiently the firm is employing use of their resources in order to generate revenue. Upon analyzing the results gained from the t = 2015 transitioning firms, it is determined that the fixed asset turnover rate decreases directly following the implementation year by 67%. However, 2 years after implementation the rate increases substantially by 162.56%, indicating that the firm has successfully employed its assets and performs efficiently. For the transition for the t = 2016 firms, it is determined that the fixed asset turnover rate increases by 19% following the implementation. However both the t = 2015 and t = 2016 show that the increase under their success that ratio (162.56% and 19%) could not be sustained and drops by 33% and 62% within the next year. A visual analysis of the firms profitability ratios also indicate that the firms investments are currently not generating adequate revenue to justify the expenses. However, for the t = 2015 firms, calculated profitability ratios indicate the firms viability has increased within 2 years of the implementation. This could potentially indicate that large Industry 4.0 investments take time in order to start generating cash. Thus, the benefit of increasing profitability under organizations are not immediately observable. Finally, the t = 2017 implementing firms show a decrease in the fixed asset turnover rate following the implementation of Industry 4.0 activities.

The fixed asset turnover rate is also an indicator of the "production capacity improvement" [5] under businesses. A low ratio shows that the investment was in an area that did not increase the capacity of the organization. However, although the inventory turnover rate seems to fluctuate between periods (for the t = 2015, 2016 and 2017 firms), a visual analysis of the individual calculations for each firm employed under the analysis shows that their overall fixed asset turnover rate are quite high. For the t = 2015 firms their average fixed asset turnover rate for the years 2016, 2017 and 2018 are as follows; 2.89, 3.88 and 1.48. The t = 2016 firms rates are 4.71 (2017) and 1.81 (2018). Finally, for the t = 2017 firms the average rate is 3.53. These results indicate that the firm currently does not have an access manufacturing capacity and that the firms are using their assets to the fullest extent. An analysis of the pre-post fixed asset turnover rates also indicate that although the rates have slightly increased following the implementation year, the amounts are fairly high and do not indicate a capacity increase within firms after the event date. However, this might be the result of corresponding increases within sales.

The final operational excellence [1] indicator is the revenue per employee ratio. This ratio was also employed as an indicator to measure the actualized benefit "improving workforce efficiency" [8]. Listed manufacturing firms have claimed that the workforce efficiency has improved as a direct result of Industry 4.0 implementation. The high amount shows that the company is generating more revenue per employee. For the t = 2015 firms the results of the analysis indicate that, contrarily to what transitioning firms propose, the employee productivity times decreased following the implementation of Industry 4.0 activities. The ratio decreases by 14% in the first year and another 16% in the following year. However, comparing the results from the year 2017 and 2018, a 16% increase is shown under the employee productivity ratio. When the results from this ratio is cross-referenced with the changes within employee numbers, it can be argued that the reduction in employee productivity is not a result of an increasing workforce. For the t = 2015 firms is apparent that, overall, employment numbers have remained relatively same from the years 2015 to 2018. For the t = 2016 firms the results indicate that immediately following the implementation of Industry 4.0, the employee productivity ratio has increased by 43%. Cross-referencing this result with the employee numbers changes for that year, it is apparent that the increase is not a result of a drop in employment numbers. In fact, employment has increased by 8% from the year 2016–2017 and has remained unchanged from 2017–2018. However, the increase in employee productivity does not remain stable and reduces by 32% in the following year. For the t = 2017 firms, there is a 98% decrease following the implementation of Industry 4.0 activities, however a portion of this decrease could be the result of the 16% increase in employment numbers. Thus, although there is an increase within employee productivity, this increase is not consistent and is not sustained within the following years.

Another actualized benefit proposed by the listed manufacturing firms as a result of implementing Industry 4.0 under their activities is a "reduction of maintenance activities" [3]. In line with the proposed benefit, we see that for all three types of implementing firms (t = 2015, 2016, 2017), there has been a consistent decrease in maintenance cost from 2014–2018. Thus, it is possible to argue that the equipment and machinery implemented during the revised production costs that has reduced the need for maintenance and repair and increased the sustainability of the long-term operation. However, lack of exact knowledge of the machinery purchased during the transition period by firms is a limitation to this argument.

Another actualized benefit put forth by manufacturing firms is that their "digital planning/innovation activities increase" [7] after the integration of Industry 4.0. In order to analyze that the R&D ratio and the R&D expense changes are analyzed. It is determined that consistently across the three types of firms (t = 2015, 2016, 2017) the R&D ratio is reduced. This indicates that the expensed R&D activities do not increase following the implementation of Industry 4.0. The result is cross-referenced by analyzing the R&D percentage changes, as well. It is determined that, except for the year 2015, the R&D expenses drop following the event date. For the t = 2015 firms, it is determined that the research and development expenses increase by 18% directly after implementation and another 22% in the following year. This lack of consistency between the R&D ratio and the expense percentage could be an effect of the fixed asset amount, which shows an increase following the implementation of Industry 4.0 activities.

The following actualized benefit analyzed under the study concerns the "reduction in expenses" or "expense efficiency" [10]. Following the integration of Industry 4.0, is argue that firms benefit as it will have an effect of dramatically reducing the expenses firms incur during their day to day business operations, such as; water, electricity, rent and equipment. In order to analyze this, the overhead ratio was employed. This ratio allows for the measurement of expenses incurred while doing business, in comparison to the income. According to the results gained from the analysis, for the t = 2015 firms, overhead expenses increased for the next 2 years until finally been reduced by 52% in 2018. For t = 2016 firms, the overhead ratio demonstrates that expenses were reduced in the following year of implementing Industry 4.0 activities by 11%. These expenses were reduced by another 11% by 2018. Reflective of the trend apparent under the t = 2015 in t = 2016 firms, t = 2017 demonstrate that overhead expenses were reduced by %123. Thus, it is possible to argue that firms have seen a drop in overhead expenses following the implementation of Industry 4.0 activities.

Another actualized benefit proposed by manufacturing firms is the "increasing reach to alternative market" [15]. This benefit was analyzed by employing use of the global sales ratio. The ratio demonstrates that following the implementation of Industry 4.0 activities, t = 2015 and t = 2017 firms demonstrate a drop in global sales by 59% and 10%, respectively. However, for t = 2016 firms in the global sales ratio shows a 12% increase following the implementation of Industry 4.0 activities. These firms global sales also reduced by 20% in 2018, signifying inconclusive results. Thus, despite the manufacturing firms argument that there the reach to alternative market Increased as a result of Industry 4.0 activities, there is a lack of financial support under their financial statements.

The next actualized benefit to be analyzed under this study is "increased sustainable growth" [14]. This claim can be analyzed by employing use of the sustainable growth ratio. This ratio serves as an indicator on whether or not firms are properly managing their day-to-day operations and provides the maximum rate of firm can sustain its operations without have to apply for additional financing. The results of the analysis showed that for t = 2015 firms, the sustainable growth ratio increases by 8% directly following the implementation of Industry 4.0 activities, and later by 50% and 45% in the next 2 years. This demonstrate that for the t = 2015 firms, can safely grow without incurring additional debt. However, this does not hold true for the remainder of the analysis. There is a decline in the sustainable growth ratio for the firms t = 2016 and t = 2017. This indicates that the sustainable growth benefit of Industry 4.0 is not consistent for all implementing firms.

Another actualized benefit proposed by transitioning firms is that "profitability increases" [12] as a results of Industry 4.0 activities. The return on assets, return on equity, gross profit margin and net profit margin ratios were employed as an indicator of the profitability of the organizations. However, upon analyzing the results presented for the three types of firms (t = 2015, 2016, 2017)—it is determined that the results are inconsistent. While the t = 2016 firms profitability demonstrates a consistent decline over the years, the t = 2015 firms the net profit margin decreases by 5% directly following the implementation and another 28% in the following year. However, by 2018 the profitability of the firm increase is by 31%. Finally for the t = 2017 firms profitability ratio increase in by 56% directly following the implementation of Industry 4.0 activities.

The next actualized benefit put forth by manufacturing firms is the "optimization of inventory" [9] as a result of Industry 4.0 activities. In order to determine whether or not inventory management has benefited from the digitalization process, the inventory turnover ratio and the stock to sales ratio is analyzed. The inventory turnover ratio (also an indicator of Logistics Efficiency [11] and Production Line Efficiency [4]) provides information on how effectively a manufacturing organization manages their inventory allows for controlling and the supply chain (supplier to customer). Industry 4.0 implementing manufacturing firms claim that their internal efficiency has been improved as a result of new IT activities (such as; check and balance systems, data collection and information systems, and interconnected-factory), proving them with the opportunity to keep less inventory on hand and subsequently reducing their holding cost. Thus, if the actualized benefit hold true, one would expect for this to be apparent under the firm's financial statements. Upon analyzing the transitioning firms, it is determined that the t = 2015 firms inventory management activities have not significantly improved following the event date (only 6% and 1%). Moreover, in by 2018 the inventory turnover ratio decreases by 42%. For the t = 2016 firms the ratio increases by 6% and decreases by 32% in the following year. Finally, for the t = 2017 firms inventory turnover ratio decreases by 40%. Second indicator of inventory optimization [9], is the stock to sales ratio. Establishing a relationship between the sales of the firm and its inventory, this ratio indicates whether or not the organization can successfully respond to the demand of the market. For the t = 2015 firms, the results of the analysis indicate that the stock to sales ratio initially decreases by 76% directly following the implementation year, however increases by %225 in the next period. The same trend holds true for the t = 2016 and t = 2017 firms. Thus, it indicates that manufacturing firms argument supporting increased inventory optimization is not reflected under financial statements.

Two other ratios contribution towards the analysis of "increase logistical efficiency" [11] are the accounts receivable turnover and the accounts payable turnover ratios. Both of the accounts payable and accounts receivable ratios are important indicators for judging logistical efficiency. The results of the analysis showed that t = 2015 firms are taking 9% longer in paying off their debts after implementing Industry 4.0. However, the ratio increases by 17% and remains nearly the same in the following 2 years. For the t = 2016 firms the accounts payable ratio increases by 17% and 11% and for t = 2017 firms the ratio increases by 6% following implementation. Thus, is not possible to claim that the accounts payable turnover signifies improvement for transitioning firms logistical activities. Upon analyzing the accounts receivable turnover it is determined that for the t = 2015, 2016 and 2017 transitioning firms cash collection from receivables have remained relatively unchanged.

The final actualize benefit analyzed under this chapter is the "improvement of stakeholder relations" [6]. According to transitioning manufacturing firms in their Industry 4.0 activities have had and improving effect on stakeholder relations. As an important goal of exchange listed firms is to maximize stakeholder value, the market value added ratio was employed as a proxy to measure the effects of the transition. This ratio not only represents the future stream of income, but it also takes into consideration the debt and equity investments within the company. The result of the analysis for the t = 2015 firms demonstrates that directly following the event date, market value added is reduced by 80%. The ratio increases by 18% then decreases by 22% in the following years. For 2016 firms the results showed that the market value added increases by 43% and decreases in the following year by 20%. Finally, for the 2017 firms, market value added remains nearly unchanged. Thus, based on the results provided, it is difficult to clearly state that market value added has consistently increased following the Industry 4.0 activities. The results of the analysis are provided under Tables 23.3, 23.4 and 23.5.

Although the sample demonstrate characteristics in line with the actualized benefits recognized by manufacturing firms transitioning towards Industry 4.0—is important to analyze these results in comparison with non-transitioning firms to determine its accuracy. Thus, Tables 23.6, 23.7 and 23.8 show the percentage difference between transitioning and non-transitioning firms for the employed ratios. 10 out of the 23 ratios were not included under this portion of the analysis because of a lack of data. The results for EBITDA, R&D Ratio, R&D Expense Changes remains unchanged regardless of the event date, with the transitioning firms consistently demonstrating higher levels, across each type of firm (t = 2015, 2016, 2017). Interestingly, non-transitioning firms demonstrates a higher-level of inventory turnover rate when compared with t = 2015 and t = 2017 firms. Indicating that the non-transitioning firms are more effectively managing their inventory. However, the Industry 4.0 implementation does not serve as a factor separating the two groups. The opposite is true for t = 2016 firms. Upon the results gained from comparing transitioning non-transitioning firms, it is determined that the transitioning firms are the ones demonstrating consistently higher levels of inventory turnover, across each year. When analyzing the stock to sales return, the results should demonstrate transitioning firms with lower results after the event date. While this is apparent under the t = 2015 firms, the decrease is consistent across each year. This indicates that the stock to sales return ratio performs better under transitioning firms in comparison with non-transitioning firms. The opposite holds true for t = 2016 firms as non-transitioning firms demonstrate a healthier stock to sales return ratio. For the t = 2017 firms, the ratio indicates mixed results. However, ultimately it is the non-transitioning firms that fared better than the transitioning from. When analyzing the results for the global sales ratio, it is determined that for the t = 2016 firms, transitioning firms fared better than the non-transitioning firms. However, as the analysis shows that transitioning firms between 2014–2018 have consistently had higher global sales then non-transitioning firms, the analysis cannot support the

Table 23.4 Changes within transitioning firms ($t = 2016$)

		t = 2016			
		2014–2015	2015–2016	2016–2017	2017–2018
Profitability [12]	EBITDA	0.5463	0.1473	0.3725	−0.0620
Workforce Efficiency [8], Operational Excellence [1]	Employee Productivity Ratio	2.3488	0.3047	0.4371	−0.3183
Employee Number Changes	–	0.0740	0.0042	0.0781	0.0024
Sustainable Growth [14]	Sustainable Growth Ratio	1.2489	0.0629	−0.1091	−0.4844
Operational Excellence [1], Production Capacity Improvement [5]	Fixed Asset Turnover	−0.0388	−0.0449	0.1923	−0.6156
Alternative Markets [15]	Global sales ratio	−0.0158	0.0235	0.1249	−0.1970
Logistics Efficiency [11], Inventory Optimization [9], Production Line Efficiency [4]	Inventory Turnover Ratio	0.0697	−0.1396	0.0585	−0.3234
Inventory Turnover Per Days	–	−0.0134	0.0589	−0.0772	0.4458
Digital Planning/Innovation [7]	R&D Ratio	0.1757	0.1925	−0.2877	−0.2877
Profitability [12]	Return on Assets	0.4790	0.2076	−0.0381	−0.4310
Profitability [12]	Return on Equity	0.5559	0.2592	0.0219	−0.2831
Stakeholder Relations [6]	Market Value Added	−0.0806	0.2471	0.4252	−0.2038
Market Value Added Per Stock	–	−0.0985	0.1176	0.5413	−0.3295
Maintenance Activities [3]	Maintenance Ratio	0.0206	−0.0283	−0.1493	−0.9081
Inventory Optimization [9]	Stock to Sales Ratio	0.1090	−0.1190	0.0463	−0.6583
Profitability [12]	Net Profit Margin	0.7038	0.6614	−0.2944	−0.1059
Stock Price Changes	–	−0.0903	0.1041	0.4196	−0.2437
Maintenance Activities [3]	Maintenance Ratio	0.2266	0.0003	0.1183	−0.9089
Logistics Efficiency [11]	Accounts Receivable Turnover	0.0446	0.0082	0.0401	0.0662
Logistics Efficiency [11]	Accounts Payable Turnover	0.0829	−0.1339	0.1707	0.1139
Operational Excellence [1]	Operating Cycle (Cash Conversion Cycle)	−0.1380	−0.0559	0.1983	0.4685
Expense Efficiency [10]	Overhead Ratio	−0.2602	0.0292	−0.1101	−0.1107
Digital Planning/Innovation [7]	R&D Expense Changes	0.3997	0.3516	−0.0908	−0.1348

Table 23.5 Changes within transitioning firms ($t = 2017$)

		$t = 2017$			
		2014–2015	2015–2016	2016–2017	2017–2018
Profitability [12]	EBITDA	1.3719	−0.0185	0.5672	0.1333
Workforce Efficiency [8], Operational Excellence [1]	Employee Productivity Ratio	0.5773	−0.0619	130.1195	−0.9877
Employee Number Changes	–	0.0549	0.0036	−0.0975	0.1645
Sustainable Growth [14]	Sustainable Growth Ratio	−0.6368	−2.6448	−1.8231	−2.8544
Operational Excellence [1], Production Capacity Improvement [5]	Fixed Asset Turnover	−0.0289	−0.1027	0.0821	−0.3038
Alternative Markets [15]	Global sales ratio	0.0049	−0.2024	0.0465	−0.1014
Logistics Efficiency [11], Inventory Optimization [9], Production Line Efficiency [4]	Inventory Turnover Ratio	−0.0534	−0.0903	0.0899	−0.3975
Inventory Turnover Per Days	–	0.0672	0.0880	−0.0966	0.5977
Digital Planning/Innovation [7]	R&D Ratio	0.6072	−0.1529	−0.0035	−0.2990
Profitability [12]	Return on Assets	−0.4079	−0.3065	0.4333	−0.2689
Profitability [12]	Return on Equity	−0.2674	−0.4723	0.7958	−0.5140
Stakeholder Relations [6]	Market Value Added	0.2581	0.0179	0.7144	−0.0324
Market Value Added Per Stock	–	−0.0046	0.1844	0.1256	−0.2549
Maintenance Activities [3]	Maintenance Ratio	−0.0635	0.1421	−0.4371	−0.9753
Inventory Optimization [9]	Stock to Sales Ratio	−0.0324	−0.1288	0.1721	−0.4357
Profitability [12]	Net Profit Margin	−0.3505	−0.3830	0.4918	0.5649
Stock Price Changes	–	−0.0020	0.1771	0.1248	−0.2404
Maintenance Activities [3]	Maintenance Ratio	0.1757	0.3230	−0.1902	−0.7521
Logistics Efficiency [11]	Accounts Receivable Turnover	0.1617	−0.0181	0.0243	−0.0528
Logistics Efficiency [11]	Accounts Payable Turnover	0.0215	−0.0345	−0.0315	0.0635
Operational Excellence [1]	Operating Cycle (Cash Conversion Cycle)	−0.0943	0.0269	−0.0492	0.8866
Expense Efficiency [10]	Overhead Ratio	87.3130	−0.9600	14.5699	−1.2254
Digital Planning/Innovation [7]	R&D Expense Changes	0.4210	0.0494	−0.0795	−0.1348

Table 23.6 Compression of transitioning to non-transitioning $t = 2015$ firms (percentage difference)

		t = 2015				
		2014	2015	2016	2017	2018
Profitability [12]	EBITDA	0.8390	0.8508	0.8455	0.8085	0.8786
Operational Excellence [1], Production Capacity Improvement [5]	Fixed Asset Turnover	0.2040	0.2060	−1.2889	0.0347	−0.0185
Alternative Markets [15]	Global sales ratio	0.5030	0.5160	−0.1654	0.4991	0.6506
Logistics Efficiency [11], Inventory Optimization [9], Production Line Efficiency [4]	Inventory Turnover Ratio	−0.2020	−0.1825	−0.0729	−0.0536	−0.2192
Inventory Turnover Per Days	–	−0.3490	−0.3256	−0.3795	−0.7794	−0.1279
Digital Planning/ Innovation [7]	R&D Ratio	0.8234	0.7343	0.7293	0.6431	0.6291
Profitability [12]	Return on Assets	0.1795	0.2571	0.4556	−0.1426	0.8149
Profitability [12]	Return on Equity	0.5373	−0.2654	1.0963	1.6712	1.0153
Inventory Optimization [9]	Stock to Sales Ratio	−0.2290	−0.1772	−3.8028	−0.4694	−0.0741
Profitability [12]	Net Profit Margin	0.3574	0.1715	0.4260	0.5336	2.5552
Logistics Efficiency [11]	Accounts Receivable Turnover	0.0493	0.1043	0.0068	−0.0453	0.0229
Logistics Efficiency [11]	Accounts Payable Turnover	0.1643	0.1223	0.0736	0.1677	0.2634
Operational Excellence [1]	Operating Cycle (Cash Conversion Cycle)	−0.7405	−0.8667	−0.6271	−0.8186	−3.8957
Digital Planning/ Innovation [7]	R&D Expense Changes	0.9829	0.9819	0.9819	0.9755	0.9759

argument that Industry 4.0 activities resulted in better performance. For the t = 2015 firms we see that non-transitioning firms had a higher global sales ratio (by 17%) than transitioning firms. However they lose in-favor of the transitioning firms within the next 2 years. The results demonstrate that the following 2 years shifts transitioning firms to the front by 50% (for 2017) and 65% (for 2018). This indicates that t = 2015 firms global sales ratio has increased (with a 1 year delay) following the event date. For the t = 2017 firms the Industry 4.0 implementation year shows transitioning firms having a higher global sales ratio then non-transitioning firms by

Table 23.7 Compression of transitioning to non-transitioning t = 2016 firms (percentage difference)

		$t = 2016$				
		2014	2015	2016	2017	2018
Profitability [12]	EBITDA	0.8426	0.8876	0.8986	0.9043	0.8892
Operational Excellence [1], Production Capacity Improvement [5]	Fixed Asset Turnover	0.1888	0.1211	0.1447	0.2057	−0.4564
Alternative Markets [15]	Global sales ratio	0.2986	0.3214	0.3515	0.4381	0.3667
Logistics Efficiency [11], Inventory Optimization [9], Production Line Efficiency [4]	Inventory Turnover Ratio	0.5226	0.5435	0.4873	0.5155	0.5195
Inventory Turnover Per Days	–	−1.1360	−1.2295	−1.2086	−1.7246	−1.0247
Digital Planning/Innovation [7]	R&D Ratio	0.7001	0.6878	0.7471	0.6082	0.6564
Profitability [12]	Return on Assets	−0.1268	0.3808	0.6346	0.4524	0.8677
Profitability [12]	Return on Equity	0.1537	−0.4505	1.0934	1.4929	1.0147
Inventory Optimization [9]	Stock to Sales Ratio	0.4583	0.5071	0.4679	0.4937	0.0580
Profitability [12]	Net Profit Margin	0.0201	0.2493	0.7043	0.7543	2.1961
Logistics Efficiency [11]	Accounts Receivable Turnover	−0.0196	0.0250	0.0673	0.0642	0.1890
Logistics Efficiency [11]	Accounts Payable Turnover	−0.0082	0.0027	−0.1080	0.0074	0.2185
Operational Excellence [1]	Operating Cycle (Cash Conversion Cycle)	−1.3142	−2.1643	−2.3863	−1.3679	−2.1735
Digital Planning/Innovation [7]	R&D Expense Changes	0.9836	0.9865	0.9882	0.9785	0.9775

4%. However, as these firms have consistently shown increased amounts in comparison to non-transitioning firms, the results cannot be offered as support of the argument. When analyzing the remaining profitability indicators employed under the chapter—it is determined that for the return on equity ratio, transitioning firms are had by 109% following the event date. One year earlier the non-transitioning firms were ahead by 27%. Following the transition year the continue to have higher return on equity rates by 167% and 100%. For the t = 2016 and t = 2017 firms the ratio continues to be a higher for transitioning firms regardless of the year. When

Table 23.8 Compression of transitioning to non-transitioning t = 2017 firms (percentage difference)

		$t = 2017$				
		2014	2015	2016	2017	2018
Profitability [12]	EBITDA	0.6250	0.8253	0.8159	0.8478	0.8542
Operational Excellence [1], Production Capacity Improvement [5]	Fixed Asset Turnover	0.3505	0.3035	0.2785	0.2617	0.2527
Alternative Markets [15]	Global sales ratio	0.1218	0.1678	−0.0205	0.0496	0.0428
Logistics Efficiency [11], Inventory Optimization [9], Production Line Efficiency [4]	Inventory Turnover Ratio	0.0075	−0.0726	−0.1393	−0.0456	−0.1647
Inventory Turnover Per Days	–	−0.4216	−0.3718	−0.3226	−0.6667	−0.1208
Digital Planning/Innovation [7]	R&D Ratio	0.3324	0.4916	0.4202	0.3579	0.4279
Profitability [12]	Return on Assets	0.2560	−0.0212	−0.0491	−0.0554	0.8016
Profitability [12]	Return on Equity	0.4254	−1.0916	1.3215	1.9650	1.0425
Inventory Optimization [9]	Stock to Sales Ratio	0.0123	−0.0301	−0.1245	0.0448	−0.0763
Profitability [12]	Net Profit Margin	0.4744	−0.0562	−0.1204	0.5597	2.2246
Logistics Efficiency [11]	Accounts Receivable Turnover	−0.0269	0.1169	0.1325	0.1162	0.1378
Logistics Efficiency [11]	Accounts Payable Turnover	0.0577	0.0117	0.0150	−0.0667	0.1204
Operational Excellence [1]	Operating Cycle (Cash Conversion Cycle)	−0.7637	−1.2952	−1.2582	−0.9901	−1.0761
Digital Planning/Innovation [7]	R&D Expense Changes	0.8829	0.9050	0.8929	0.8076	0.7984

analyzing the results for the return on assets ratio, is determined that only the t = 2017 firms demonstrate an increase following the event date. The analysis shows that following the implementation of Industry 4.0 activities, the difference between transitioning and non-transitioning firms return on assets ratio increases by 80%. In the prior here, and transitioning firms were ahead by 6%. Thus, it is possible to claim that Industry 4.0 activities have resulted in higher profitability levels in transitioning firms and then non-transitioning firms. A similar argument cannot be made for t = 2016 firms. However, the t = 2015 firms to indicate a 46% difference between transitioning and non-transitioning firms, in favor of the former. Unfortunately, non-transitioning firms move ahead in 2017, providing inconsistent results. The final profitability ratio remaining under the analysis is the net profit margin. The results for this ratio demonstrates consistently higher amounts for t = 2015, 2016, 2017 firms, regardless of the event date. Contrarily, the cash conversion cycle shows consistent higher amounts for non-transitioning firms. The accounts receivable turnover is determined the t = 2016 and t = 2017 firms indicate that her collection rate for transitioning firms. However, following the implementation of Industry 4.0 (1 year delay), non-transitioning firms outperform transitioning firms by 5% under t = 2015. The accounts payable turnover rate t = 2016 in t = 2017 transitioning firms demonstrates higher results in comparison to non-transitioning firms following the event date. This indicates that, following the implementation date of Industry 4.0, non-transitioning firms have a slower payment schedule for their liabilities and hold on to their cash longer. For the t = 2015 transitioning firms consistently demonstrate a slower payment schedule, regardless of the event date.

23.5 Conclusion

Despite the literature's professed support that the benefits of Industry 4.0 are wide encompassing, a financial ratio analysis conducted on the data collected from the listed transitioning manufacturing firms demonstrates ambiguous results. By analyzing the actualized benefit put forth by implementing manufacturing firms, the chapter attempted to offer a solution to the theoretical mismatch between analyzed measures and outcomes. The analysis has demonstrated that when taking into account the initial event date (Industry 4.0 application year) of firms, the results offer better clarity. When comparing the t = 2015 firms with the t = 2016, 2017 (the initial transition year of the Industry 4.0 movement of the firm), it is apparent that the former outperforms the latter. The reason t = 2015 transitioning firms have performed better and demonstrated the actualized Industry 4.0 benefit under their financial statements could be related to first mover advantage. Considering Lieberman and Montgomery (1988)'s argument, first mover are able to generate positive economic benefits and show greater efficiency in comparison to late adopters. The sample was analyzed according to financially measurable, actualized Industry 4.0 benefits. Regarding operational excellence; the cash conversion cycle and fixed asset ratio outcomes firms demonstrated mixed results—indicating that transitioning firms were not using their resources in an effective manner, that also generated revenue. However, as mentioned before, the early adopters faced a decrease in their cash conversion cycle. Moreover, calculated profitability ratios showed that the viability of these t = 2015 firms had increased following implementation. Firms also argued that their capacity had increased as a direct result of implementing Industry 4.0 activities under their operations. However, the fixed asset turnover ratio does not show a capacity increase within firms after the event date. The final indicator of operational excellence employed under the study, revenue per employee ratio, identifies that t = 2015 firms employee productivity increases following the next 2 years after implementation. However, although there are increases in the productivity ratio following the implementation of Industry 4.0 under the t = 2016 and t = 2017 firms, the increases are not consistent and are not sustained within the following years. Interestingly, the results of this study show that, following the implementation of Industry 4.0 activities under organizations, maintenance expenses and other expenses (such as, utilities) are reduced for transitioning firms across each type (t = 2015, 2016, 2017). However, actualized benefits, such as; increased digital planning and integration activities, increase alternative market reach, improvement of stakeholder relations, increased logistical efficiency, optimization of inventory are not detected under transitioning firms financial statements. The final benefit, increased sustainable growth finds that t = 2015 firms are able to safely grow without incurring additional debt. Similar to the results gained from the other benefit analysis, t = 2016, 2017 firms show inconsistent results. The relative performance of the 2015 firms indicate that large Industry 4.0 investments take time in order to start generating cash. Thus, the benefits are not immediately observable. When analyzing the results in comparison to non-transitioning firms it is determined that Industry 4.0 implementation does not serve as a factor separating the two groups. Thus, the hypothesis that the Industry 4.0 movement in Turkey has positively affected the operations of implementing BIST manufacturing firms is partially rejected. A limitation of this study is the fact that manufacturing firms annual activity report do not provide detailed information on the level of Industry 4.0 application (full integration of Industry 4.0 within operations or specific application). Although these firms mention the focus of the integration (e.g. employee training, increased facilities, machines, etc.) they only do so briefly. One reason for this is the current transition towards Industry 4.0 and the firms wishes to preserve their advantage against their competitors. In order to account for this, this chapter equalizes the level of application across the sample. However, future research could take into consideration the discrepancy between application levels and account for it when trying to empirically compare transitioning firms. Another limitation of the study is the fact that most countries and firms have only recently started gaining awareness of the Industry 4.0 movement. Thus, in time the analysis could be repeated by including newly transitioned BIST firms and comparing the results across a wider period range.

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Chapter 24
Dark Factories from an Industry 4.0 Perspective: Its Effects on Cost Accounting and Managerial Accounting

Ali Kablan

Abstract In accordance with the Industry 4.0 perspective that the developing and developed countries have focused on recently, accounting profession and members of this profession are required to play a new role. Nowadays, together with globalization and the improvements in technology, businesses have been influenced by Industry 4.0 which not only affects them directly, but also without a doubt influences the accounting science. The integration of Industry 4.0 into businesses influences accounting science, cost accounting and management accounting. Thus, this study is significant because it contributes to the relations between cost and management accounting, and leads the way for new research. In this study, the effects of Industry 4.0 on accounting science were investigated while emphasizing that the traditional understanding of accounting has been evolving into "Accounting Engineering". The aim of the study was to investigate the Industry 4.0 effects on cost and management accounting. Within the scope of this study, the roles of cost and management accounting in dark factories, which have the potential to become the production business of the future, were discussed. This study suggested that the existing accounting perspective should be changed. As a result of completed studies, various suggestions in accordance with Industry 4.0 have been put forward to reduce human error and wastage, better manage time, increase production capacity and quality, reduce costs and provide a competitive advantage.

24.1 Introduction

Although the fundamental goal of each industrial revolution is to increase productivity, none of them in history has fallen behind using avant-garde technologies in areas from production to sales, finance to accounting (Can & Kıymaz, 2016: 108).

With The First Industrial Revolution, occurring at the end of eighteenth century, steam machines in factories began to be used. With the Second Industrial Revolution

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occurring at the beginning of the twentieth century, mass production was made possible as a result of electricity. As of 1970, the Third Industrial Revolution occurred with the improvements in automation in industries due to the electronic and information technologies (IT). Nowadays, the Fourth Industrial Revolution is currently taking place connecting value chains from end to end by means of cyber-physical systems and dynamic data processing (TÜSİAD, 2016: 19).

Industry 4.0 is the fourth industrial revolution introduced at the Germany-Hannover exhibition in 2011 (Lu, 2017). Sensor, data, information and operation are the most important factors of Industry 4.0 which is different from the previous industrial revolutions. With the combination of these four factors, unqualified labor is removed, thus obtaining faultless operations. In other words, Industry 4.0 aims to create added value revolution by establishing automation in unqualified works and specializing qualified works (Şener & Elevli, 2017: 26).

Industry 4.0 can be described as the digitizing of the manufacturing environment providing communication between the factory and its environment by creating a digital value chain via automation (Oesterreich & Teuteberg, 2016).

The aim of Industry 4.0 is to reach an operational automatizing level of higher productivity and performance (Thames & Schaefer, 2016).

The main objectives of the businesses during the Industry 4.0 is to improve their long-term competitive powers by increasing flexibility and productivity in production through communication and rationalism (Gabriel & Pessl, 2016). In the meantime, apart from reducing long periods in innovation and marketing, increasing productivity of source and energy efficiency, horizontal and vertical integration and digital integration of engineering have been aimed through value networks (Prause, 2015). In this context, Industry 4.0 has the potential to create positive sustainability effects in all value chains by coming up with easier solutions to financial problems as a result of increasing productivity and privatizing products in accordance with customers with the help of a translucent and observable production system (Wagner, 2016).

Developed countries have determined and adopted own strategies rapidly for the fourth industrial revolution. Some examples of these strategies are given in Table 24.1.

Industry 4.0, on which developed countries place their focus, aims to make all departments that are related to production directly or indirectly work in cooperation with one another and make digital data, software and information technologies work together integrally (Schuh, Potente, Wesch-Potente, Weber, & Prote, 2014: 1). Together with Industry 4.0, it is expected to increase the efficiency and capacity of factories by integrating humans, machines and systems with one another (Erturan & Ergin, 2017: 16). In this context, it can be said that the perspective of connecting things is the most significant feature of Industry 4.0.

Table 24.1 Fourth industrial revolution strategies of developed countries (Tübitak, 2016: 2)

	SMLC Smart Manufacturing Leadership Coalition	Coalition of Intelligent Manufacturing
	SPIRE Sustainable Process Industry through Resource and Energy Efficiency	Sustainable Process Industries with the yield of Source and Energy
	PLATTFORM INDUSTRIE4.0	Industry 4.0 and Digital Economy
		Society 5.0
	CATAPULT High Value Manufacturing	Interference of Value Added Manufacturing
		Industry Interference of Future

24.2 Internet of Things (IoT)

The concept of Internet of Things (IoT) was developed by Cisco Systems which is a company in network services. This concept expresses the advanced conditions where the physical and digital worlds are integrated (Greengard, 2017: 33).

While Chui, Löffler, and Roberts (2010) described IoT as connecting physical objects to internet, Atzori, Iera, and Morabito (2010) described it as intersection area of internet and semantic dimensions.

Ashton (2009) claimed that the current internet perspective depends on the data input of computers by humans. Based on this claim, he stated that the time, information of humans and correct data input were limited. He also emphasized that the internet should not only obtain information from humans, but also from things. According to Ashton, if the internet connects with objects, mistakes caused by humans will decrease, and the information pollution will be reduced in the near future.

Based on the descriptions given above, IoT can be described as a communication network through which all objects with physical features whether they are living or non-living are connected with data networks (Erturan & Ergin, 2017: 15).

In order to gain advantage in the global competition, business firms have started to search and improve opportunities of applications in IoT. Not only things but also the human participation will provide great benefits to the development of IoT. Therefore, perspective of IoT is expected to evolve into 'Internet of Everything'

(IoE) in the future (Erturan & Ergin, 2017: 27). The decisive aim of IoT systems is to create synergy in different systems.

24.3 Industry 4.0: Accounting Approach Based on Internet of Things

Together with IoT, it is inevitable for the approach to accounting to enter to a process of change. Learned things as in all fields will also be effective on the accounting systems without a doubt. Thanks to IoT, many activities such as accounting records, inventory counting, stock orders and controls, accuracy and completeness of physical goods, depreciation times and amounts with regard to the physical goods, following of the purchasing and sales etc. will be able to be carried out simply and recorded without humans in the business firms of the future which are called intelligent firms. All recorded information will create big data bases called Big Data. For this reason, obtaining useable and meaningful information and submitting useful information correctly and promptly to the information users will require specialty. Together with Industry 4.0, members of profession who can use technology, and design systems will be required and the accounting science will turn into 'Accounting Engineering'.

Since all systems will become integrated with IoT, place and time conceptions in the accounting process will be unimportant. Thus, with the cloud accounting programs used in recent years, members of profession will be able to work at futuristic offices without accounting offices. Together with the improvement of information technologies, it will be enough to turn on the computer in the internet environment. This new accounting office model will provide great advantages for not only employees but also for employers with regard to reducing costs (Yürekli & Şahiner, 2017: 158).

Conventional accounting applications are expected to become real time accounting applications with the help of Industry 4.0. Together with using cloud accounting program, the automatic entry of data to system and remote access will be provided and accounting operations will be real time (Yürekli & Şahiner, 2017: 158). With the accounting approach in the internet environment of things, information users will be able to have real time knowledge about the operations activated in businesses at any time. Thus, the opportunity to obtain knowledge and warn the management will be possible while the weekly and monthly activities still continue, not after they are completed.

In addition, the audit process of accounting has been going through a transformation as the manual auditing based on printed documentation has been replaced by the permanent audit of the electronic data in digital environments (Rezaee, Elam, & Sharbatoghlie, 2001: 151).

According to M. Medvedev, the accounting profession will be divided into two as 'Notary Accounting' and 'Creative Accounting'. In the future, notary accountants

Table 24.2 Most suitable professions to computerization

Possibility	Occupational group
0.99	Tax Adviser
0.97	Property Consultancy
0.97	Restaurants
0.94	Accounting

will complete duties regarding deals and agreements which are within the scope of the accounting application. As for Creative Accountants, they will be responsible for analyzing internal activities of a company checking, planning or organizing which are beyond formal accounting (Slyyozka & Zahorodnya, 2017).

In a study carried out in the US on the future of employment for 702 members of profession, their compliance to technology was investigated (Schwab & Samans, 2016). According to the study, professions that are the most suitable to be computerized are as shown in Table 24.2.

The results of the study show that tax advisers and the members of the accounting profession who work on financial fields in companies will be influenced enormously from digitalization in the future. Together with the intelligent factories, it is inevitable that conventional accounting systems will become the intelligent accounting systems, in other words, will become Accounting 4.0 due to using intelligent manufacturing systems.

In a study released by Business Insider, the profession of accounting was ranked second among all the professions that are expected to go through a transformation within 20 years with the technological developments and advanced in robotics (Yarow, 2014).

The other improvement that accounting is estimated to have effects on in the future is Big Data. In 2012, the Association of Chartered Certified Accountants (ACCA) conducted a research on what the 100 most important factors dominating the global accounting profession were. As a result of this research, it was determined that one of these factors would be Big Data in ten years (ACCA and IMA, 2013: 5). By taking advantage of Big Data and using it effectively, businesses can make a gain in yield by approximately 5–6% (Warren, Moffitt, & Byrnes, 2015: 397).

Warren et al. (2015) stated that, together with IoT and Big Data, the quality of accounting information will increase and become more transparent and realistic value works belonging to balance sheet items will achieve a solution on a global scale. On the other hand Krahel and Titera (2015) claimed that the effect of Big Data will lead to changes in accounting and report standards. Thanks to Big Data, instead of focusing only on the presentation of standards, it is thought to be more beneficial for information users to focus on analyses.

While the effects of Industry 4.0 on accounting science are not known exactly, it is thought that there will be a real-time accounting system that records data, including all accounting functions such as making record, reporting, classifying, summarizing by intelligent machines, intelligent manufacturing systems, intelligent shelves, intelligent warehouses, intelligent stocks etc. Intelligent systems will keep the necessary real-time records when each financial function is performed. It is

Table 24.3 Industry 4.0—Accounting functions on approach to IoT

Recording	Classifying	Reporting	Analyze and comment
Will be performed by Accounting Information System	Will be performed by Accounting Information System	Will be performed by Accounting Information System	Will be performed by a professional in accounting

thought that the members of the accounting profession will become the people who design the system and analyze the reports prepared by the system in this intelligent system. Thus, the members of the accounting profession will become system designers or system consultants in accounting organizations. A professional in accounting is expected is to retrieve the terabyte-sized data related to the financial transactions, make it eligible for analysis, analyze it and make the results meaningful for the users (Erturan & Emre, 2018: 194) (Table 24.3).

As a result of the accounting profession being compatible with Industry 4.0, a decrease in mistakes will be seen and financial reports will be prepared at a higher quality.

24.4 Dark Factories and Their Effects on Cost Accounting

The aim of cost accounting is to determine product cost. Product cost includes three basic factors: Direct Raw Materials and Supply, Direct Labor Cost, General Production Costs (Mirza, 2008: 493). In dark factories, three factors are used to determine product cost but as a result of removing labor costs, there will be two factors, which will be material and general costs.

In the manufacturing business, in addition to general accounting that meets the requirements of outer information users, recording the operations in the production process until the product is completed in accordance with principles and techniques has brought up the cost accounting perspective. Observation of the production processes with a system until the end product is complete enables business managers to have sufficient information on time. By only this way, it is possible to improve the decision-making process of managers.

In future business firms, all business functions are aimed to be carried out and maintained in electronic environment. The biggest value created by human force in the Big Data system will be the designer function (Erturan & Ergin, 2017: 17). At this point, the kind of change that cost accounting will go through with the dark factories comes to mind, which is also the topic of the current study.

In previous chapters, intelligent electronic systems that are integrated in all kinds of tool and filled with sensors and processors as well as having internet connectivity called IoT that all devices use for data and information interchange among one another are given the name ‘cyber-physical systems’. With the usage of cyber-physical systems in machines in the production process, companies that can carry out production independently from human force by coordinating and optimizing on their own are described as Dark Companies (Koç, 2017: 2).

If Dark Companies, which are a current issue with the Industry 4.0 strategy, become reality, production period, costs and necessary energy for production will decrease and production quantity and quality will increase (Koç, 2017: 2). As a result of the technology transfer in Dark Factories, effective observation of product life, self-organization, an unproblematic production process and real-time profitability calculations will become possible.

The digital factory of Siemens, located in Amberg, Germany, is accepted as the most suitable factory for the aforementioned technology. The production capacity of the factory, which was established in 1989, can be increased 8 times without making any changes to the production plant. While 75% of the completed work is carried out by intelligent machines, 25% is still carried out by labor force. Product completion percentage is 99.99%, which shows that no production defect or wastage will come up with Dark Factories (Erturan & Ergin, 2017: 17).

The production costs of a lot of companies coordinated with Industry 4.0 will decrease by approximately 15–25%, except for the raw material costs. It is predicted that this progress will influence the manufacturing sector by 90–150 billion euros in Germany alone. When raw material costs are included, it is thought that the total productivity recovery will reach the levels of 5 and 8%. For example in Germany, by providing an increase of 1% of GDP, a growth of 30 billion dollar per year is expected (TUSIAD, 2016). Apart from its effects on the progress of countries, it also has significant effects on businesses. When the estimated effects are examined, decreases in inventory, maintenance and quality costs, increases in the efficiencies of technical personnel etc. come into prominence. As a result of these gains, which are the most important factors in production, it is aimed to provide a growth in total productivity. With this productivity growth which will be in various sectors, the national competitive capacity will be increased (TUBITAK, 2016).

24.4.1 Effects on Labor Costs

In traditional calculations of production costs, most of the cost factors are indexed to labor force. Together with Industry 4.0, especially with decreasing rate of unqualified labor force in production, it is inevitable that calculations of unit cost and break-even point will be different. Therefore, cost calculations and accounting systems will operate in a different way.

Another issue which is as important as technological improvements is the changes in the contents, numbers and varieties of conventional production factors. With the concept of Dark Factories, there will be a change in value based on labor force. It is inevitable that the presence of labor force will change in the economic sector with dark factories. While employment will not be required in some jobs due to high level automation, new employment opportunities will arise. As a result, jobs in the production process will reduce therefore reducing the costs of blue-collar workers. As for high-graded white-collar workers, new employment opportunities will arise which will increase the costs (Aegean Region Chamber Of Industry, 2015: 25). In both cases, while the direct labor costs directly related to production decrease, indirect labor costs will increase. In brief, while the employment opportunities and costs of unqualified labor are expected decrease, the employment opportunities and costs of qualified labor are more likely to increase.

The International Robotic Federation of the US has reported that the demand for industrial robots has increased compared to previous years and it is estimated that this increase will continue. In 2020, the turnover for robot sales is expected to be 40 billion dollar on a global scale (Banger, 2018: 31). This shows that many jobs will be carried out by robots in the future. The utilization of robots as labor force and their effects on employment is called 'technologic unemployment'. Technologic unemployment is generally described as the losing of jobs and professions due to technologic improvements (Aegean Region Chamber Of Industry, 2015: 38).

In a study conducted by the Pew Research Center in 2014, 48% of the participants, who answered the questionnaire regarding artificial intelligence, robots and future of jobs, accepted that robots will replace blue and white collar employment in the future. The remaining 52% think that technology will not cause unemployment until 2025. These results not only show that many jobs will be undertaken by robots, they also highlight that new employment fields and sectors will arise (TUSIAD, 2016).

A report published by OECD in 2016 titled 'Providing of next production revolution: Future of production and services' indicated that new technologies will provide jobs through many direct and indirect mediums and technologies which will increase productivity growth and be beneficial for businesses as well as the economy. In the same report, it was indicated that major problems would arise in many countries if labor migrations in sectors occurred. Thus, unqualified labor will be replaced by machines. It is estimated that the concept of low-cost labor will lose popularity and thus factories based on low-cost labor centered in Asia will be moved back to their countries of origin due to dark factories. This will lead to big industry migrations in the near future (Toker, 2018: 61).

Öztuna (2017) indicated that Industry 4.0 will cause big unbalances between production and consumption. In the new economic model, as salary, ssi premium, severance pay which are normally given to employees will not be given to robots, the employers will save a large amount of income and therefore, income inequality will increase in society. In such cases, policies will be required to be put in effect to collect taxes from robots. Furthermore, this can cause industrial unions to lose popularity and the elimination of the employment security.

24.4.2 Effects on Material Costs

Intelligent product systems, corporate management systems, operation process and consumption systems are deeply integrated in Industry 4.0. The life cycle records of products (from raw material to consumption and to the waste process) can be used to improve the product and design other products (Huang, Yu, Peng, & Feng, 2017). These records prevent unnecessary raw material stock and the production of low-demand products. In addition, they provide the recovery of products that have been completed their economic and technical life. As a result of the 'Global Industry 4.0 Questionnaire' in which more than 2000 firms participated, it was estimated that, together with Industry 4.0, the decrease rate of annual costs will be 3.6% in industries and increase rate of % productivity growth will be 4.1%. This situation will provide the usage of less sources during production.

While the basic production stage in conventional industry are modelling, molding, casting and smoothing, future technology will use systems via which products will be obtained by 3D Printing. A model created with computer software will be directly produced by 3D printers. This is an important factor in rapidly reducing production costs. 3D Printers are able to produce molds without barely any wastage (OECD, 2017). By using 3D technologies in production, defects that occur in the production process will be eliminated and wastages will be prevented. Therefore, while the duration of production processes and the use of sources will be minimum (Toker, 2018: 60).

In addition, with the help of IoT, it will be possible to obtain various data from the machines placed in the production area. By analyzing and evaluating this data, high performance will be obtained in less time using less sources and wastage rates will be decreased dramatically (Banger, 2018: 180). Data obtained from Big Data especially contributes to the inventory observing processes. For example, instead of using IFO and FIFO methods to determine inventory costs, using data obtained from Big Data enables inventory costs from the system to be seen in real time and instantly (Aslan & Ozerhan, 2017: 869).

Furthermore, cloud informatics platforms will connect all things with each other and with ERP, determine the needs of raw materials and turn orders into automatic and real time. On the other hand, intelligent machines and devices will be able to inform about replacing the products that are old or past their expiration dates.

24.4.3 Effects on General Production Costs

Energy is one of the most important inputs in producing a product or service. Using energy effectively directly influences the general cost of businesses. With Industry 4.0 technology and IoT, things such as automatically managed heaters, ventilation systems and air conditioners increase productivity and reduce costs (Banger, 2018: 182). In addition, production quantity and quality will also increase while raw material wastages will decrease. Energy and water sources will be used no more than required and harmful effects on environment will be reduced (Economic Forum, 2016: 18).

In addition to providing convenience, by keeping up with technologic improvements, Industry 4.0 and Dark Factories also lead to an increase in various costs, such as technology acquisition costs, set up costs, maintenance costs, software updating costs, building adaptation costs for making easier of robots movements, leasing costs, expert labor costs, new generation artificial intelligence costs and robot automation costs. According to Rojko (2017), Industry 4.0 and Dark Factories are expected to decrease production costs by 10–30%, logistic costs by 10–30% and quality management costs by 10–20%. However, in a fully automatic factory, the investment return rates are not yet attractive enough for businesses today.

According to Dirican and Mil (2017) who conducted studies on financial confusions, tourism establishments that invest in high technology are required to revise their government promotions such as tourism incentives, tax refunds and to improve their financial record systems for amortization and seniority indemnities. In cases where robots are seen as fixed assets in the production system, whether or not additional tax will be collected regarding finance and employment and how much maintenance expense will be cut from tax assessment is a matter on its own.

In addition, Depreciation Accounting will become significant for businesses that are mostly automated. All arrangements that law-makers will make regarding this point will be significant for businesses which must be closely followed.

According to the results of a research conducted in the US, the share of general production costs in total cost showed a regular increase in the last centenary in industries. Nevertheless, it was observed that direct labor costs showed a decrease at the same rate. In accordance with this improvement, instead of direct labor cost savings, providing general production cost savings become a more primary issue in terms of productivity growth for managers of today's businesses (Miller & Vollmann, 1985).

After the given explanations, the effects of Industry 4.0 on the production–cost process are as follows:

– Data and information exchange with production plant and products in real time,
– Instead of mass production, preferring private production according to customer demands,
– Increasing productivity by optimizing the consumption of raw materials and sources,
– Using less energy sources, thus reducing the harmful effects on the environment,
– Actively using robots in the production process,
– Increment on fixed asset investments,
– Increase in the amount of depreciation,
– Reducing the requirement of labor force in the manufacturing sector,
– Obtaining minimal losses, defects and wastages in production,
– Improving occupational health and safety,
– Flexible working hours,
– Using 3D printers,
– Establishing more telescopic relation between cyber world for production and consumption,
– Calculating instant profitability per unit,
– Changing equal production quantities,

– Increasing production speed and quantity,
– Working 24/7 production plants,
– Using continuous inventory methods.

24.5 Effects on Industry 4.0, Big Data and Management Accounting

As can be understood from its name, Management Accounting functions as a bridge between ‘business management’ and ‘accounting’ and is a part of accounting. The aim of management accounting is to provide necessary numeric information so that the managers can make correct decisions (Mirza, 2008: 28). The auditing, internal auditing, internal control, cost accounting and management accounting applications are especially influenced by Big Data (Aslan & Ozerhan, 2017: 869).

The regular data on recorded sales, inventory costs, profitability, raw material and labor expenses, over working hours etc. and will enable firms to analyze this data in the light of statistic and operational researches to make future decisions. As the importance of Big Data grows with IoT, businesses will take action to analyze the data and take action immediately (Greengard, 2017: 60). When Big Data is analyzed well with various chosen methods, strategic decisions will be taken correctly and risks will be directed with better methods by corporations.

Video recordings which play a role in the Big Data factors are applications that contribute to observe labor productivity, measure production quantity and determine deficiencies and when and how many times the limited access areas are entered (Aslan & Ozerhan, 2017: 870). Managers, who want to monitor factories visually will be able to check via cameras, screens, IoT and robots in the digital environment. If managers demand the visuals of inventories, ware houses, production, sales and shipping processes, they will be able to receive them without referring to related departments. Thanks to coordinated instant audit, financial tables can be prepared whenever requested and can be subjected to continuous audit action. Footnotes, which are essential to financial tables, will be produced automatically in the IoT system. The effects of video recordings, sound recordings and data on the accounting applications are listed as follows (Warren et al., 2015: 398).

– In terms of finance accounting, video images of inventories and fixed assets make it easier to take precaution regarding any impairment in businesses.
– The periodic analyzes of management meeting videos in terms of content, feeling and conceptions provide information about work and audit risks.
– Sound data of business activities can improve the quality of accounting records and financial information. Some important sound sources include monthly or quarterly conference meetings, shareholder and board of management meetings, customer calls, personnel calls, microphones placed in business premises and other sounds from video sources. With the help of these sources, Big Data can provide additional proof so as to support accounting records. For example, voiced

recordings made with civil engineers in building phases can provide additional proof to determine estimated building worth or building lifespan. These recordings can solve the problems regarding the evaluation of asset principles and potential impairments in the future for accountants. In addition, analyzing voices obtained from customer phone calls can give information about customer satisfaction and product quality and thus be used for guarantee obligations.

– The other factor of Big Data is text data which is not numeric. These data are files related to capital markets, e-mails, web pages, social media and social news etc. These data are additional mediums that contribute to the evaluation and improvement in the performance of businesses in terms of management accounting aims.

The effective management of Big Data requires qualified human resources in this field. A study by ACCA was conducted on how Big Data will influence businesses and what the opportunities and threats will become for the accounting profession within 10 years. In a research report of ACCA, it was reported that accounting professions must improve themselves in the fields below to turn Big Data into an advantage and improve themselves within 5–10 years (ACCA and IMA, 2013: 15).

– Today, Big Data is accepted as an asset in businesses and its importance increases day by day. Big Data is thought to create wealth in approximately 10 years. Therefore, it will be required to calculate the value of Big Data. In this context, accountants will need to have various skills such as describing data as a value, choosing accepted evaluating methods and determining estimations. However, data evaluation is difficult. Intangible assets, becoming increasingly important in the information economy, shows the hiding tendency in reporting. This data is not easy to measure. Furthermore, deprecation referring to Big Data is a very important issue. Increment in data rates means increment in wearing rate. As the new data becomes appropriate, old data will become invalid.
– Using Big Data to make decisions.
– Using Big Data in risk management.

In a study conducted with 790 members of the profession, it was explained that accountants will benefit from Big Data mostly for financial reports, management and audit, internal auditing, determining of risk, making decision and planning, determining costs (Aslan & Ozerhan, 2017: 881).

As it can be seen from the given explanations, accounting departments will undertake more extended duties with Industry 4.0 as organizational structures. From the sufficiency of accountants and creating strategy to describe new job models, accountants will become dominant and effective in making decision.

As a result of stronger corporate management, societies' expectation will rise regarding the role of accountants in the prevention of cheat, corruption, money laundering and other unethical applications.

Governments will be under ever-increasing pressure due to the increase of transparency and accountability in reporting. For this reason, governments will

Table 24.4 Dark Factories and their effects on cost accounting and management accounting

Cost-management accounting topics	The effects of dark factories (Industry 4.0)	
Direct Raw Material and Supply Costs	↓	Will show a decrease due to the decreases in product defects and wastages
Direct Labor Costs	↓	Will decrease as the distance between technology and human labor grows rapidly
General Production Costs	↑	Will increase due to the increment in deprecation costs and manager labor
Order Cost System	↑	Will increase with customer oriented production
Plant Cost Systems	↓	Will decrease with customer oriented production
Rate of Wastage	↓	Will decrease with Iot, intelligent warehouses and intelligent shelves
Waste Quantity	↓	Will decrease with Iot, intelligent warehouses and intelligent shelves
Production Quantity and Speed	↑	Will increase with 24/7 continuous production and automation
Production Errors	↓	Will decrease as the distance between technology and human labor grows rapidly
Fixed Costs	↑	Will increase with the increment in fixed assets and depreciation expenses
Changing Costs	↓	Will decrease with the decrease of energy sources and labor
Fixed Assets Investments	↑	Will increase due to mechanical, software, patents etc.
Management Labor	↑	Will increase due to the decrease in unqualified works and specializing on qualified work
Cut Taxes From Labor	↓	Will decrease with the decrease in the number of workers
Severance Pay	↓	Will decrease with the decrease in the number of workers
Working Hours	↓	Will decrease with automation and cloud communication
Productivity	↑	Will increase with the decrease in production errors and wastages
Break-Even Point[a] $BEP = \frac{\text{Total fixed cost}}{\text{Unit sale price} - \text{Unit changing cost}}$	↑	Will increase as a result of the invesments in fixed assets, as the increment of total fixed cost is more than changing costs
Reporting and Time of Making Decision	↓	Will decrease with Iot concurrent financial reporting
Clearness and Accountability	↑	Will increase together with concurrent financial reporting, making calculations of profit per unit possible

[a]'Break—Even Point'; or 'Zero Point' that the company has neither profit nor loss can be described as sales volume. At this point, total income is equivalent to total expenditure (Mirza, 2008: 418)

need the assistance of accountants more than ever. This will lead to the increase in the effects of the members of the profession on governments (Türker, 2018: 225).

The positive and negative effects of dark factories on cost and management accounting are listed in Table 24.4.

24.6 Conclusion

The First Industrial Revolution focused on steam power while the second on mass production and the third on the power of computers and revolutions in automation. As for the Fourth Industrial Revolution, the focus has been given to ‘Internet of Things’.

The aim of the Fourth Industrial Revolution is to create a flexible world in which the cyber and physical production systems are integrated on a global scale where the dark factories will become a reality. Thus, providing the products completely exclusive to customers, minimizing costs and creating new operation models can become possible. In addition, the sustainability conception of Industry 4.0 will provide very important opportunities regarding the environment, society and economy and will support the use of sources effectively.

This study is a theory on the effects of dark factories that occur with Industry 4.0 on cost and management accounting. According to the results of this study, asset management and audit in businesses will get easier with Industry 4.0. Due to dark and intelligent factories becoming widespread, intelligent machines, intelligent shelfs, cloud technology and IoT, cost calculating and cost management will lead to high quality with both low cost and less time. Calculations of unit product cost and profitability per unit will be possible concurrently. By performing concurrent controls during production, cases of malfunction, stealing, misappropriation etc. will be informed to the responsible managers and the protection of assets will be provided. Together with the automation period, thanks to the effective use of time and minimization of human error competitive advantage will be provided. This very period starts with the supply stages until the consumer is informed about the product. This period continues from the supplying of the inventory item that is needed for production until the production line is observed and the customer is informed. The accounting records of businesses will also be integrated into this period. It is inevitable that the integrated system will lead to differences in conventional cost and management accounting methods.

In conclusion, the latest stage of technology, the distance between technology and human labor grows rapidly by means of dark factories. The three factors of production cost will be reduced to two, including material and general costs, as labor costs will be removed. It is evident that there is still a long way to go as even people in Germany, which has an advanced industry and was the first to use Industry 4.0, stated that they cannot sit back and watch what would happen with Industry 4.0.

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Part V
Cybercrime, Legal Aspects and Relevant Topics

Chapter 25
Evaluation of Cybercrime Economy via MCDM and Decision Tree Approaches: The Case of Zonguldak

Zafer Öztürk, Mehmet Pekkaya, and Muhammed Temli

Abstract One of the most important economic problems that developed/ing countries are facing today is the informal economy. Unregistered economic activities are generally defined as all economic activities that are not included in national accounts. The informal economy has an informal structure as well as a criminal structure. Cyber-attack/s (CA) are increasing day by day as an important part of the informal economy due to the economic effects they produce. Credit card fraud, emptying a bank account, cryptolocker viruses that can be used to encrypt data on the user's computer, the use of websites and e-commerce sites such as DDOS attacks, espionage, information smuggling, and many new computing crimes can be given as examples in this field. This study aims to evaluate the relations/determiners of CA-damages and information technology (IT) investments to firms' economics and present the findings to the researchers/decision makers.

In this sense, IT investments and CA/CA costs to 321 Zonguldak firms having more than 20 employees in 2016 have been surveyed by Turkish Statistical Institute. According to CA-damage severity indexes generated via TOPSIS, statistical methods and decision tree approaches supported by regression analysis are used in the analysis. According to the analysis, CA-damage increased as IT investments increased. IT investments dimensions' existence of "website/mobile applications" and "IT policy implementation" accepted the main CA-damage determiners.

This study is based on the master's thesis entitled "The Economic Dimension of Cyber Crime: The Case of Zonguldak".

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Meanwhile, the firm's less usage of firewalls/IPS/IDS indicates that CA are not fully understood, and the security policies' application is also important along with its preparation.

25.1 Introduction

Cybersecurity is such a concept that it becomes more and more important with each passing day. Cyber-attack/s (CA) that lead cybersecurity studies are not purposeless acts or means of entertainment that only young people do for fun. Companies which handle the issue from a perspective of 'It doesn't matter! We can scan the computer with an anti-virus program and if necessary, we can re-install it' have begun to understand that the truth is not so, by experiencing a high amount of financial and moral losses. CA are now threatening not only computers and technological devices but also human life. Criminal cases such as, committing suicide of a 12-year-old girl in United States due to long-term cyberbullying (Milliyet, 2013), and committing suicide of a high school student in Australia who threw herself under the train because of the pressure from the internet users (Hürriyet, 2012) show very clearly what the consequences of CA can lead to.

Cybercrime/s (CC), becoming progressively widespread and complicated, have more strong economic influences than traditional crimes. On the other hand, some specific features of CC such as technology and skill-intensiveness, a higher degree of globalization than traditional crimes, and newness make them structurally different (Kshetri, 2010). The financial loss, caused by the computer viruses that turn users into zombies due to the back doors opened, and the ransomware that encrypts all data on the computer and requires money to decrypt it, passed over a billion dollars in the world in 2016 (Xtrlarge, 2017). Especially in 2017, ransomware called WannaCry impacted 200 thousands of people and firms including Russian banks, UK hospitals, and European automobile factories and showed that the financial losses because of CA would be much bigger (Internethaber, 2017).

Although the informal economy, crime, economy, and crime economics have been examined in detail in the literature of different disciplines, the economic implications of CC have not been fully studied yet. This study draws attention to the fact that CC should be investigated not only by engineering departments but also in all other fields. Although there are different aspects of CA in different disciplines, the economic aspects of CA will be studied in this study. It is unthinkable that the science of economics, which is familiar to every field of life, is unrelated to the cyber world.

The objective of the study is to evaluate the relations and determiners of CA-damages in terms of information technology (IT) investments from the perspective of firms' economics, and reveal the results to investors, decision makers, and researchers. In this study, the term of IT investments contains IT technical infrastructure, IT human resource, firewall/IPS-IDS/antivirus usage, the website/mobile application of firms, etc. This study also shows that decision support systems (DSS) are an applicable approach to such an analysis. The study also aims to understand the situation clearly against CA in Zonguldak and to contribute to further regional or national studies. In accordance with this general purpose, the companies have been asked questions to understand their cybersecurity culture, such as the level of exposure to CA, their perspectives against attacks, how much resources are allocated to information processing units, IT infrastructures, whether the extent of the attacks which have financial losses can be determined, how much labor loss caused by attacks, to what extent firms can detect this and the size of the IT infrastructure used by the firm.

In the data analysis along with some basic statistical tests namely *t*-tests and Pearson correlation analysis, multi-criteria decision making (MCDM) and data mining (DM) methods are used as DSS approaches. Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), one of the MCDM methods is used for generating index scores for representative variables and logistic regression based on decision trees (DT) in DM methods are used for determining the IT investment factors affecting the CA.

The second part studies crime-economics relationship and cybercrime, the third part mentions about CA types and the fourth part is about CC's economic costs. Materials and methods of the analysis and results of the analysis are reported at part five and six respectively. The conclusion part consists of inferences of results and some proposals.

25.2 Crime-Economics Relationship and Cybercrime

Although the factors that cause crime vary according to societies, it has caused problems for societies and individuals for centuries. The basic assumption of crime economics is the rationality of the criminal (Aksu & Akkuş, 2010). The economic model of crime or crime economics has been developed under the leadership of economists such as Fleisher (1963) and Becker (1968). The model of the crime economy is generally an assessment of the planned distribution of time between work and crime, based on the idea that the crime is eligible for a materially identifiable gain (Witte & Tauchen, 1993). After the 1980s, micro analyzes have been conducted to determine the tendency of criminals to commit a repeat offense, and specific deterrence issues have discussed in addition to the power of general deterrence in the analysis (Aksu & Akkuş, 2010).

Internet started as a military project in the 1960s and entered public life in the 1990s (Friedman, 2011). The progress of internet and all information systems consisting of electronic communication systems and infrastructures have caused significant changes, and it has also changed operational activities such as finance, electronic communications, transportation, energy, and management. This change has occurred not only in the legal area but also has affected the crime and has diversified the methods of the crime. The use of information technology in economic crimes brings different qualities to the crimes committed, and on the other hand, it gives rise to the addition of CC to general crime distinctions that are the subject of crime economy.

In the literature, economic crimes are defined as crimes caused by violations of any economic activity of people or society (Tiryaki & Gürsoy, 2004). In other words, the gains as a result of activities defined as crimes in terms of law are also referred to as crime economy. According to Aydın (2006), the crime economy is the underground economy consisting of illegal activities. In the literature, economic crime is defined as an illegal act committed through professional techniques such as fraud, deception, and deception using technical skills to obtain unfair income by persons who have professional or technical abilities. However, there is a physical area in the processing of classical crimes (Brenner & Schwerha, 2001). Observation of the crimes committed in the physical environment can be done with human senses. However, this situation has changed over time. With the changing world order, a virtual environment developed outside the physical world. In the internet world called 'artificial universe' or 'metaphysical environment', there has been information moving but not people (Jamet, 2010). This new world, which offers many opportunities and chances, has brought along security threats. Analogies have made to define this new world, such as 'Wild West' because the criminals are comfortable (Jamet, 2010), 'Unsafe Highway' to express the challenge of protection (Broadhurst, 2006), 'Global Village' because the physical distances come closer (Özbek, 2015). In the broadest sense, the internet world which is shaped by information and communication networks refers to cyberspace.

Traditional criminal acts differ in some aspects from CC acts. While traditional crimes occur within geographic and social boundaries in real time, CC are not limited to time, place or area. In traditional crimes, there is a consensus on what constitutes a crime or not, however, for many aspects of CC, this consensus has not been achieved. CC debates are often crime oriented while traditional criminology is often criminal oriented (Peker, 2010).

The impacts of financial cybersecurity violations in the world are increasing day by day. Although the methods are changing CC is increasing (Avşar & Öngören, 2010). The number of enterprises experiencing CA is increasing day by day. In particular, the increase of targeted CA threatens critical infrastructures and sectors of strategic and economic importance. The Global Risks Report of World Economic Forum in 2018 includes CA and data fraud or theft in the top five (WEF, 2018). In particular, the number of new variants of Malware software was 274 million in 2014, while in 2016 more than 357 million were identified (Symantec, 2017). Due to CC, the economic loss is estimated to reach $3 trillion by 2020 (WEF, 2018).

The crime has now moved to internet. It is also known that people can suffer even deathly physical damage due to the impact of CA that do not remain only in the digital world. In addition, although the perpetrators of CC can cause great harm to others, they do not feel any responsibility for the damages they cause due to the fact that the crime is processed in a virtual environment and the damage may not be observed directly (Dolu, 2011). The only consequence of the WannaCry attack, which has inflicted around 200,000 computers in 150 countries and has had heavy financial damage, is not economical. In particular, the damages of the virus to health systems and many public institutions in some countries (WEF, 2018) have caused the disruption of public services.

CC brings a heavy cost financially. The use of new generation communication tools in every sector will increase in the next period following the developments in artificial intelligence, robot technology, space technology, and Industry 4.0 which is defined as the intelligent production period in which every object with economic value can communicate with other devices via internet (Aksoy, 2017). Industry 4.0 is a new generation industry which can plan its own production, capacity, and supply chain (Özdoğan, 2018). It is likely that new weaknesses will occur in the robots that will be used in the production system where the virtual and physical systems are in contact with each other, and the objects connected to the internet will thus be wise, as well as in computers that control the robots and other intermediate equipment involved in this technology. The exploitation of these weaknesses will further increase the crime economy.

25.3 Classification of Cyber-Attacks

The classification of CC with respect to certain characteristics provides convenience for understanding the attack. The relationship among certain types of crimes and the differences among types of crime that are similar to each other can be understood in this way.

One of the most widespread methods in examining the types of CA is unauthorized access (Kadir, 2010). Connecting a network or other offline systems such as computers and servers without permission (Hekim & Başıbüyük, 2013), due to different reasons such as system defect and personal failure, is called unauthorized access. Unauthorized access to computer networks is described as an attack. Unauthorized access may be to a small part of the IT infrastructure or to the whole system or may be in the form of remote areas or direct access.

Another type of attack is called as "phishing" attack. Phishing method which consists of the abbreviation of 'Password Harvesting Fishing' is defined as the cheating of individuals using the facilities of information systems. The phishing, which uses weaknesses in human nature such as reliance, rashness, and fear (Chen & Walsh, 2009), especially emerges as e-mails or counterfeit websites. In this method, e-mails which are sent to users are seen as coming from a known source, as an urgent message, advantageous or attractive opportunity, noticeably high invoice debt or appropriate credit information. When you follow the link in the e-mail, you are directed to a malicious website trying to get your username/password (Temli, 2015, 2019). In the first quarter report of Anti Phishing Working Group (APWG, 2018) published in 2018, phishing attacks increased by 46% to 263.538 in the first quarter of 2017 compared to the last quarter of 2017. Users are subject to billions of dollars of financial damage each year because of phishing.

Another method used by the attackers is the targeted phishing attack. The most obvious feature that distinguishes this attack from the classic feeding attack is that it is directed at a goal. According to Temli (2017), such attacks are used to steal the data of the companies, rather than stealing the bank information of the users. The danger level is significantly high as it is specifically studied for targeted attacks.

Internet banking attacks are CA to all kinds of banking transactions. In recent years, internet banking fraud has reached serious dimensions. In the UN, EU, humanitarian organizations or a bank image, attacks supported by fake documents and mask stories, increase the effects through phishing methods or Web Spoofing (attacks using the fake website address) (Camlı, 2010). Attacks are also supported by fake phone numbers (MASAK, 2011).

One of the most important elements of many CA is undoubtedly Social Engineering because even the most advanced security systems are managed by human beings (Gündüz & Resul, 2016). In the technical sense, it is very difficult to overcome these security systems. However, the human weakness factor enters the circuit at the point of exceeding these systems (Vural & Sağıroğlu, 2011). Human beings are the weakest link in the security chain system (Canbek, 2005). Social engineering attacks that are seen as the use of human relations or carelessness of people, presents the process of preparing the ground for the attack (Camlı, 2010) or the stage of entering the system (Chen & Walsh, 2009). Briefly, it is called the art of obtaining data that cannot be possessed using or without technology (Mitnick & Simon, 2013). Nowadays, social engineering is used in conjunction with methods such as phishing, Shoulder Surfing and Reverse Social Engineering (Küçüksille, Yalçınkaya, & Uçar, 2014). Even in the most advanced security systems in the world, the use of human weaknesses neutralizes the effectiveness of the used technical safety efforts (Arslan & Bal, 2013).

The basic principle of DoS/DDoS attacks, also known as service demolition, is to limit the access to the server and to prevent the system from functioning properly instead of damaging the system. The DOS attack is a type of attack that makes the systems inoperable, while the DOS attack is called the DDOS (Distributed Denial of Service) attack from multiple sources (Önal, 2012). The DOS attack can be expressed as an attack to prevent users who really want to use the service from using (Canbek & Sağıroğlu, 2007). These attacks often target sensitive parts of network such as bandwidth, security devices, and servers buffer memories, CPU power, memory, TCP/IP protocol and cause the system to become inadequate to provide normal service (Rouse, 2013).

DOS attacks are one of the most important problems of the internet (Cepheli, Büyükçorak, & Karabulut Kurt, 2014). Since 1996, many sites on the internet have been attacked and various methods have been tried to prevent the attacks. DDOS attacks are more dangerous than DOS attacks (Weiler, 2002).

Backdoors are the methods that allow the attacker, who connects remotely and is not seen by an ordinary check over of the system, make connections by skipping identity checks (Gökce, Şahinaslan, & Dincel, 2014). Attackers, who access the system by using a variety of different methods, create different open doors that they will know for their later access to be effortless. With this method, subsequent connections are provided automatically in a shorter time or when each computer is turned on (Haeni, 1997). Attacking a computer is not the only way of creating a backdoor. This can be allowed by the use of free programs prepared by the attackers, browser weaknesses, and the ads loaded with the web page (Özel, Kaya, & Eken, 2014). Keyloggers are spyware that keeps records of all operations from the keyboard. Keylogger saves usernames, passwords, addresses, and other information in a text file and sends them to the attacker via e-mail, FTP or remote connection. They can be hidden inside a keyboard or USB memory or they can be hidden in software. Hardware keyloggers are often difficult to recognize (McAfee, 2013). They monitor the commands written, by providing a connection to the attacker as soon as they begin to use.

A computer worm is a malicious software that can be self-replicated because of network connections that are infecting the computer and are often unnoticed by users. Worm software can spread rapidly as they can replicate on their own. Worms are independent programs (Haeni, 1997). The biggest danger of the worms is that they replicate a large number of themselves. For example, a worm can pass a copy of itself to everyone in your email address list and then attack to their mailing list. Worms can cause the network to be locked because users are using network infrastructure (İTÜBİDB, 2013).

There is no doubt that software vulnerabilities have an important place in providing cybersecurity. Software vulnerabilities are defined as defects that cause security breaches due to the technical features of the software (Ozment, 2007). Any program deficit on the computer is enough to compromise the whole system. When an attacker wants to enter a computer she collects data about the computer. The operating system, office software, compression programs, and other program versions used are important data sources for hackers. The vulnerability could be on a computer as well as it could be on a file server, web server, domain server, mail server, firewall, or VPN server (TBD, 2006).

25.4 Economic Costs of Cybercrimes

Today, CA are among the most important threats that countries are exposed to (Hein & Çelikkafa, 2010). Private information is stored and sold on the deep of the internet by using the IT systems. Credit card information, mail accounts, and identity information are the most common items that are stolen and sold. In the CSIS, 2014 report, the internet economy, which is a big part of the global economy, is estimated to generate \$2 trillion to \$3 trillion annually, while CC cost 15–20% of the value generated by internet technology (CSIS, 2014). Again in the CSIS 2018 report, the cost of CC to the global economy is about \$445 billion (Lewis, 2018).

In STM Defense Technologies 2016 October–December period cyber threat status report, DDoS attacks are reported as the most serious attacks. Although there are serious DDoS attacks worldwide, the attack on the US-based firm Dyn DNS cited as the most remarkable attack because of the methods used in, it causes different sizes of transportation problems in many countries including Turkey (STM, 2017). While the attack costs the US$7 billion (Shiftdelete, 2016), the most striking and different aspect of this attack is the use of a malicious software called as Mirai Botnet that causes the use of many devices (i.e. DVR, IP-based camera, satellite receiver, ADSL modem), called Internet of Things in CA. This attack particularly indicates its presence in developing countries such as India, Saudi Arabia, China, Iran, Turkey, Tunisia, Russia, the Philippines, Colombia, Peru, Egypt, and Bangladesh due to their IP-based geographical location (Baumgartner, 2017). The Mirai using the logic of attempting to login via default user name and passwords has gained access to the devices since most of the devices connected to the Internet are produced without considering the security measures, connecting to the internet with the default user name and password, the home users who use the devices have no access to the security of those (Bilge, 2016).

In 2016, there were significant attacks, especially on the banking sector. The attackers were particularly interested in more money-making methods, identity fraud and phishing attacks increased. There have been many attacks against the SWIFT (Society for Worldwide Interbank Financial Telecommunication) system, which provides an electronic fund transfer standard among banks all over the world. The attack not only stole bank credentials but also provided access to victims' computers via remote access systems (Waqas, 2018). Attacks started with Bangladesh banks and finally resulted in $951 million of theft. By the way, in December, the same type of attack on the Central Bank of Russia resulted in a $31 million thefts. Attacks were also made against Turkish banks and it was announced that some banks were affected by the attacks and their financial losses ($4 million) were covered by the insurance fund (STM, 2017).

As a result of CA, companies suffer from the greatest economic loss due to the stealing of trade secrets. The information that the merchant uses during her commercial activities, or which does not yet have commercial value (Yılmaz, 1995), but has the potential to value in the future (Coleman, 1992) is considered as a trade secret. Trade secrets are very important for companies and loss or theft of them gives financial and moral damages to companies. According to US data, US firms were exposed to intellectual property theft at about $50 billion in 2009 (Hekim & Başıbüyük, 2013).

Ransomware is the fastest growing CC industry. Victims of ransomware include large companies, small and medium-sized businesses, and individual users. The cost due to the ransom attacks to the individual is lower than the other kinds of CA (Lewis, 2018). Unlike other attacks, victims of this type pay the cost of attack therefore, global costs of the attacks are continuously increasing. According to the FBI data, the ransom payments of $24 million in 2015 were determined as $209 million only in the first quarter of 2016. At the end of 2016, the loss is estimated to exceed $1 billion (Metzger, 2017).

The number of malicious activities on the internet is quite remarkable. ISP as a major internet service provider reports that the number of malicious scans has reached 80 billion per day as a consequence of the auto-efforts of CAers to find

Table 25.1 Estimated daily cybercrime activity

Cybercrime	Estimated daily activity
Malicious scans	80 billion
New malware	300,000
Phishing	33,000
Ransomware	4000
Records lost to hacking	780,000

Source: Lewis (2018)

Table 25.2 Regional distribution of cybercrime 2017

Region (World Bank)	Region GDP (USD, trillions)	CC Cost (USD, billions)	CC loss (% GDP)
North America	20.2	140–175	0.69–0.87
Europe and Central Asia	20.3	160–180	0.79–0.89
East Asia and the Pacific	22.5	120–200	0.53–0.89
South Asia	2.9	7–15	0.24–0.52
Latin America and the Caribbean	5.3	15–30	0.28–0.57
Sub-Saharan Africa	1.5	1–3	0.07–0.20
MENA	3.1	2–5	0.06–0.16
World	75.8	445–608	0.59–0.80

Source: Lewis (2018)

out vulnerable targets (Lewis, 2018). Table 25.1 shows the estimated CA amounts for 1 day.

CSIS's estimation claims that in 2014, the cost of CC was between \$345 billion and \$445 billion all over the world and this cost approximately equaled to 0.62% of global GDP. According to CSIS, which assert that the range is between \$445 and \$600 million by using the same method, the ratio of the cost of CC to global GDP was 0.8% in 2016. Table 25.2 shows the economic extent of CA and the ratio of costs from CA to GDP by regions.

Statistical information revealing the economic costs of CC is very limited in both World and Turkey. The main reason for this limited information is that companies do not disclose CA that they are exposed to because of reputational, psychological and economic concerns. As in the examples all around the world, all kinds of CA have an economic response. In addition, cyber-attacked firms experience many additional costs to clear the system from viruses caused by CA, to close the system deficits, to reinstate the system and not to be attacked again.

25.5 Materials and Methods

25.5.1 Objective and the Data

The objective of the analysis is to evaluate the relations and determiners of CA-damages in terms of IT investments, namely IT technical infrastructure/human resource, firewall/IPS-IDS/antivirus usage, website/mobile application of firms, etc. from the perspective of middle/big firms operating in Zonguldak/Turkey. This study is a kind of DSS application and shows the applicability of DSS approaches on this type of analysis.

The data of the analysis is obtained from a special survey on Zonguldak firms of our project surveyed by Turkish Statistical Institute (TSI) which is the Turkish government agency appointed for official statistics on Turkey, such as population, resources, economy, etc. Zonguldak is a city which is located in the northern Anatolian Black Sea region in Turkey. According to TSI (2018) population data, Zonguldak was ranked 35th in 2016 and 597,524 people lived in. It has a gross national product 14.26 billion TL (about $4.75 billion) which was 0.55% of Turkey in 2016. Since TSI is an official institution of Turkish government, all the firms have to give accurate answers for the survey questions. Accordingly, random sampling techniques can be conducted with acquired firm characteristics and firm list which are operating in Zonguldak. The questionnaire was applied to companies employing more than 20 employees in Zonguldak. According to TSI data, the number of companies employing more than 20 personnel was 386 in 2016. Forty-two of these companies were not operating, four companies were assigned, three companies are non-active and one company is not included in the survey because it is repetitive. Therefore, obtained questionnaire answers from 321 firms employing more than 20 personnel, randomly selected by TSI used for the analysis. Since the sample was randomly selected, it is decided that all the inferences from the analyzes represent firm properties that have more than 20 personnel. The questionnaire contains 32 main items/questions and their sub-questions which are listed in Appendix

Table 25.3 Some firm characteristics of the sample

Q31-Revenues	f	%	Q32-Personnel	f	%	Q4-IT department existence	f	%
=<100	20	6.2	1–19	81	25.2	IT department does not exist	281	87.5
100–500	36	11.2	20–49	146	45.5	IT department exists	32	10.0
500–1000	73	22.7	50–99	52	16.2	Total	313	97.5
1000<	189	58.9	100–249	29	9.0	Q6-Firewall usage	f	%
Total	318	99.1	250=<	9	2.8	Firewall does not exist	225	70.1
			Total	317	98.8	Firewall exists	92	28.7
						Total	317	98.8

f Frequency

1. As it is seen at Table 25.3, the majority of the firms in the sample can be admitted as middle size category according to their personal numbers.

The questionnaire procedure is conducted for the studies of Temli (2017) and Öztürk, Pekkaya, and Temli (2017). Our study contains a way out analysis of Öztürk et al. (2017) and some differentiating analysis with respect to the unpublished study of Temli (2017) but using the same raw data. As Temli (2017) and Öztürk et al. (2017) uses frequency and Chi-square analysis in their researches, moreover Temli (2017) also uses statistical tests for generated index series via TOPSIS. In this study, eight index series are generated for IT investments and six index series are generated for CA (and damages) with respect to two scenarios via TOPSIS. Integrated index series with respect to two scenarios via TOPSIS by using generated indexes are the main data of the analysis conducted in this study. In the following parts, TOPSIS one of the MCDM methods with index series generating approaches used in this study and DT one of the DM methods with used algorithms in this study are mentioned. Pearson correlation analysis, independent sample *t*-test, regression analysis which are used also in the analysis are not explained since they are well-known basic statistical tests.

25.5.2 MCDM, TOPSIS Method and Generated Index Series

Complicated or even ordinary problems which have more than one criterion/variable/goal simultaneously instead of only one need to use MCDM techniques. MCDM techniques stand for solving such problems by using analytical and systematical way. So many MCDM techniques exist and they have various advantages developed for solving the MCDM problems. AHP, ANP, ELECTRE, PROMETHEE, TOPSIS, GRA are some of these MCDM techniques. MCDM techniques have some application on stock trading, energy planning problems, product design, product selection, facility location, and facility layout planning, achievement order, financial applications, bank performance evaluation, etc. (Hamzaçebi & Pekkaya, 2011; Pekkaya & Demir, 2018). Accordingly, even in daily life, decision makers may inevitably use MCDM approaches, when the problems that have more than one variable/criteria in decision procedure. As weighted mean calculation can be considered the simplest MCDM technique that is commonly used in daily life in selecting or ordering alternatives, modern MCDM techniques such as ELECTRE, PROMETHEE, TOPSIS, GRA take into account relations/pair distances between the alternatives' scores, or/and both minimum-maximum scores of the alternatives for each criteria in selecting/ordering alternatives. MCDM techniques are usable for determining priorities of the criteria, exploring the interrelations between the criteria or/and selecting/ordering/grouping the alternatives (Pekkaya & Demir, 2018). In this study, TOPSIS is used for generating index series for each firm, in order to represent the severity of experienced CA and/or IT investments. These index series are generated for statistical analysis and DT.

Table 25.4 Calculation steps of TOPSIS

	Notation	Explanation
1	A decision matrix (A) is prepared, with the cell elements a_{ij}. Alternatives: $j = 1,2, \ldots, J$ and criteria: $i = 1, 2, \ldots n$	
2	$r_{ij} = a_{ij} / \sqrt{\sum_{i=1}^{n} a_{ij}^2}$	A matrix elements are standardized
3	$v_{ij} = w_i \cdot r_{ij}$	The weighted standardized decision matrix can be formed. The w_i are the weights of each criteria, giving the sum of 1
4	$A^* = \left\{ \left(\underset{i}{makv} v_{ij} \middle\| j \in J \right), \left(\underset{i}{\min} v_{ij} \middle\| j \in J' \right) \right\}$ $A^- = \left\{ \left(\underset{i}{\min} v_{ij} \middle\| j \in J \right), \left(\underset{i}{makv} v_{ij} \middle\| j \in J' \right) \right\}$	Based on the criteria, the positive ideal (A^*) and unwanted negative ideal (A^-) solutions are determined for the alternatives. The J here represents the benefit, and J′ represents the cost
5	$D_j^* = \sqrt{\sum_{i=1}^{n} \left(v_{ij} - v_i^* \right)^2}$; $D_j^- = \sqrt{\sum_{i=1}^{n} \left(v_{ij} - v_i^- \right)^2}$	Euclidean metric (vector sum of deviations from the ideal and non-ideal solution set) of each alternative is calculated
6	$C_j^* = D_j^- / \left(D_j^* + D_j^- \right)$	The relative distances of each alternative to the ideal solution are calculated. The order of preference is made from a large number to a small number

Source: Pekkaya and Aktogan (2014)

TOPSIS technique has various applications on generating indexes for alternatives. Some of them are on staff selection (Ecer, 2006), service quality of SERVQUAL dimensions for hotels (Pekkaya & Başaran, 2011), selecting professions (Pekkaya, 2015), laptop selection (Pekkaya & Aktogan, 2014), bank bankruptcy risk evaluation (Pekkaya & Erol, 2018), etc. The TOPSIS method was developed by Chen and Hwang in 1992 with reference to Hwang and Yoon's study in 1981 (Jahanshahloo, Lotfi, & Izadikhah, 2006).

TOPSIS technique is preferred because it is practical and commonly used. Via TOPSIS technique we can generate indexes for each alternative by taking into account the principle of being away from the non-ideal solution and the closest to the ideal. The calculation steps of the TOPSIS method can be presented in Table 25.4.

In this study, eight index series are generated for representing IT investments with using 32 questions/subquestions and six index series are generated for experienced CA (and damages) with using 20 questions/subquestions, via TOPSIS. And also one more CA-damages index series named index Y, for a general representation of such attack is also generated. Totally, 15 index series are generated via TOPSIS method and raw data, and this procedure is recalled scenario A for TOPSIS calculations. All the components of the indexes and their priorities in the indexes are presented at Table 25.5. As it is seen, Y consists of index Y1–6 and Q21, Q22.1, but for Y6 component, only Q28.1, Q28.4, and Q28.5 questions are taken into consideration,

Table 25.5 Generated indexes and their description

Index	Components (questions used)	Description	Abbreviation	Priorities of components
X1	Q1,Q2,Q3	IT Technical infrastructure	TechInf	Equally weighted
X2	Q4.1,Q4.2,Q5	IT Human Resource	HumRes	Equally weighted
X3	Q7.1,Q7.2,Q7.3,Q10,Q14	Firewall and IPS-IDS Usage	FIPSIDS	Equally weighted
X4	Q8.1,Q8.2,Q9.1,Q9.2	Antivirus Usage	AntVirus	2/6, 1/6, 2/6, 1/6
X5	Q11.1,Q11.2,Q12,Q13,Q15, Q30.1	Website and mobile application	Website	Equally weighted
X6	Q24,Q25	SOME Unit	SOME	2/3, 1/3
X7	Q27.1,Q27.2,Q27.3,Q27.4	IT Security Policy	SecPolicy	Equally weighted
X8	Q29.1,Q29.2,Q29.3,Q29.4, Q29.5	Policy Implementation	PolImpl	Equally weighted
Y	Q16.1–3,Q17.1–3,Q18.1–3, Q19.1–3, Q20.1–3,Q21, Q22.1,Q28.1,Q28.4–5	All Attacks	AllAttac	Q18.1–3 are weighted 2/23, others 1/23
Y1	Q16.1,Q16.2,Q16.3	CA experienced in mobile applications and websites	WebAttac	1/5, 2/5, 2/5
Y2	Q17.1,Q17.2,Q17.3	CA by email	EmAttac	1/5, 2/5, 2/5
Y3	Q18.1,Q18.2,Q18.3	CA on servers	ServAttac	1/5, 2/5, 2/5
Y4	Q19.1,Q19.2,Q19.3	CA such as virus worms	VirAttac	1/5, 2/5, 2/5
Y5	Q20.1,Q20.2,Q20.3	Phishing CA	Phishing	1/5, 2/5, 2/5
Y6	Q28.1,Q28.2,Q28.3,Q28.4, Q28.5	Data Loss	OthAttac	Equally weighted

since Q28.2 and Q28.3 conditions are not observed. The CA on the server questions (Q18.1–3) are weighted twice since they thought as more important than others in general representation of CA-damages.

The values of generated index series via TOPSIS are continuous between 0 and 1, then these values are multiplied by 100 for more understandable values away from too many decimals. Since almost all generated index series have very high heterogeneity and/or positive skewness, another scenario is activated for generated index series. According to scenario B, all the data are square rooted before TOPSIS calculations. In the analysis of this study, all the generated index series are arithmetic mean values of the generated index series of scenario A and B.

25.5.3 Decision Trees (DT)

A DT is a map and contains a series of related classification nodes which drive the best choice from the data set via mathematical algorithms. In the data analysis, along with some basic statistical tests namely *t*-tests and Pearson correlation analysis, DSS approaches are also used, namely TOPSIS and DT. DT can be thought in DM methods. After correlation analysis, in order to determine the IT investment factors that affect the CA, firstly ordinary least square (OLS) regression with generated index series and logistic regression (LR) techniques with categorized generated index series of Y are applied from the perspective of statistical approach. However, no robust rational/explainable model is obtained after more than ten trying scenarios, so some of the obtained relations are used as foreknowledge on following DM approaches namely DT which is a nonparametric method. Parametric methods have some assumption which must be satisfied, such as normality, non-multicollinearity, homoscedasticity, linearity, etc. As LR has less assumption, DT approaches almost have no assumptions. This study also is experienced some of these problems and shows that DT approaches can be applicable, alternative to regression analysis, especially to LR analysis.

DM techniques are actually a part of the knowledge discovery process and used to explore hidden /useful patterns of knowledge from large databases. The DM and DT applications are for finding the final results especially in an exists/not exists query or true/false problem (1/0) that is one of the most inspiring works and a difficult task. The DM has become a widespread research instrument for decision makers/ researchers to identify/exploit patterns and interaction among variables and made them able to forecast and in classification type analyses (Venkatesan & Velmurugan, 2015). DM and DT applications can be thought to have revolutionary promotion in the information processing system with the support of computers, and summarizing useful information by means of a number of analytical tools and techniques. The goal of DT is to build a model that foresees the value of a target variable based on numerous input variables. DT is a fast/accurate widely used method to model classification/prediction with handling high dimensional data and it can be simply converted to classification rules (Bhuvaneswari, Prabaharan, & Subramaniyaswamy, 2015). There are lots of DT algorithms that may use different analytical tools/ techniques in information processing systems, namely J48, CRT (Classification and Regression Tree, or CART) and CHAID (Chi-squared Automatic Interaction Detection), etc.

J48 (new version of C4.5 algorithm) classifier is a very commonly used DT model, firstly desires to create a decision tree based on the attribute values of the available training data. Whenever it encounters a set of items, training set finds the attribute that distinguishes the several instances utmost clearly. This feature can help the classification of them the best, namely have the highest information gain (Bhuvaneswari et al., 2015). Some indicator of the J48 and also DT algorithm models can be expressed by using Confusion Matrix (Table 25.6).

Table 25.6 Confusion matrix or classification performance instruments

		True condition or nature		
	Status	A	B	Total
Predictions or classifications of the model	A	TP (True positive)	FP (False positive)	A′ (Predicted As)
	B	FN (False negative)	TN (True negative)	B′ (Predicted Bs)
	Total	A (Total A)	B (Total B)	A + B

CHAID algorithm used by Kaas in 1980 in order to determine the best classifications. CHAID algorithm used in direct marketing model, classifying the credit rating as good/bad, estimating the relationship between school activity, estimating the combined categories and subgroups of independent variables in reaching the factors that affect the children's wishes (Albayrak & Koltan Yılmaz, 2009). CHAID models can be decided according to chi-square test statistics for each node.

CRT is quite flexible and Gini impurity measure is found to maximize the homogeneity of child nodes with respect to the target variable. CRT like other DT algorithms is a nonparametric classifier that it does not make any assumptions about the distributions of the variables. CRT has some advantages over other statistical classification methods and deals effectively with big data and dimensionally high issues (Albayrak, 2009).

For the goodness of fit measures of J48, CHAID and CRT algorithms, kappa statistics, accuracy, F values can be taken into account for general performance of the models (Table 25.7).

25.6 Analysis Results on Cyber Attacks-Damages

25.6.1 Generated Index Series Descriptive Statistics and Inter-correlations

The generated index series which are calculated via arithmetic means of generated index series of scenario A and scenario B are evaluated in this part of the study. The descriptive statistics of these series are presented at Table 25.8.

As it can be seen at Table 25.8, the generated index series has very high variance and right-skewed because of the range between mean and maximum values. So, independent sample *t*-test and regression type statistical analysis may produce unfair statistics. Accordingly, for especially statistical analysis the all generated index series are taken natural logarithm, after adding the value 1 for producing non-negative and non-left skewed values. The series has a little less coefficient of variation values which represent homogeneity after taking their logarithms. The following analysis is Pearson correlation which also investigates linear relations

Table 25.7 Some goodness of fit measures

Measures	Formula	Explanation
Recall/Sensitivity	TP/(TP + FN)	Cases that were correctly identified of all A predictions
Precision	TP/(TP + FP)	Cases that were correctly identified of all As in nature
F	(2∗Recall∗Precision)/(Recall+Precision)	The harmonic mean value of Recall and Precision
Accuracy	(TP + TN)/(TP + TN + FP + FN)	The correctly ratio of predictions. Accuracy value of 0.5 may be thought predictions are by chance, so it must be higher than 0.5
E(T)	$(A*A' + B*B')/(A + B)^2$	Expected agreement (true predictions)
Kappa (K) statistics	(Accuracy-E(T))/(1-E(T))	Prediction power or agreement (Viera & Garrett, 2005) $0 < K$ not acceptable agreement, $0.41 < K < 0.60$ Moderate agreement $0.01 < K < 0.20$ Slight agreement, $0.61 < K < 0.80$ Substantial agreement $0.21 < K < 0.40$ Fair agreement, $0.81 < K < 0.99$ Almost perfect agreement
Chi-Square	CHIAD algorithm prediction agreements for each node in branching can be controlled by a statistical approach. If the *p*-value of Chi-square statistics is significant at 0.05, the branch is acceptable	
Gini index, Gini criterion function, and improvement	*Gini index* gets the maximum value of (1-1/k), where k is the number of categories for the target variable. When all cases of a node belong to the same category, the Gini index equals 0 *Gini criterion function* can be calculated by taking into account the proportion of cases sent to the left child node and to the right child node. A split is chosen to maximize the value of this function which is reported as the *improvement* in the tree (Ture, Tokatli, & Kurt, 2009) in CRT algorithm	

between series, so this conversion of series to logarithmized ones may help to get relations. Pearson correlation analysis results are given at Table 25.9.

The correlation between the CA (Y) to a firm and IT investments (Xs) are statistically significant at 0.01 in all dimensions. The correlation is at moderate degree for X7-SecPolicy (0.421), at low degree for the other variables (0.163–0.318). Accordingly, IT investments and CA of a firm are correlated that means as IT investment increases CA may be higher in severity, vice versa. No statistically significant correlation at 0.01 with moderate degree for CA components is observed with IT investments components, but near to moderate degree X7-Y3 (0.370) and X7-Y6 (0.368) statistically significant correlations can be observed.

For especially using some algorithms in DT analysis of DM approach, generated index series converted to ordinal scaled data. Some index values may be equal to 0 when no score is detected in the components of that index. In the process of categorization, 0 values conserve their position, other values are categorized relatively, in ordinal scaled and with respect to determined critical values which is

Table 25.8 Descriptive statistics of generated index series

	Statistics of generated index series					Statistics of logarithmized index series[a]				
	Min	Max	Mean	StdDev	CoV	Min	Max	Mean	StdDev	CoV
X1-TechInf	0.00	99.55	1.558	5.575	3.58	0.00	4.61	0.754	0.415	0.55
X2-HumRes	0.00	100.00	0.775	5.713	7.37	0.00	4.62	0.293	0.416	1.42
X3-FIPSIDS	0.00	81.18	9.126	14.052	1.54	0.00	4.41	1.254	1.505	1.20
X4-AntVirus	0.00	97.81	5.881	6.432	1.09	0.00	4.59	1.709	0.676	0.40
X5-Website	0.00	65.88	3.417	8.186	2.40	0.00	4.20	0.856	0.937	1.09
X6-SOME	0.00	85.71	1.335	9.689	7.26	0.00	4.46	0.107	0.614	5.76
X7-SecPolicy	0.00	100.00	2.733	15.325	5.61	0.00	4.62	0.161	0.802	4.97
X8-PolImpl	0.00	100.00	7.311	14.250	1.95	0.00	4.62	1.398	1.123	0.80
Y-AllAttac	0.00	50.09	0.652	3.421	5.24	0.00	3.93	0.202	0.524	2.59
Y1-WebAttac	0.00	75.86	0.641	5.329	8.32	0.00	4.34	0.082	0.476	5.80
Y2-EmAttac	0.00	55.14	1.194	6.373	5.34	0.00	4.03	0.179	0.661	3.69
Y3-ServAttac	0.00	77.86	0.918	6.402	6.97	0.00	4.37	0.113	0.576	5.08
Y4-VirAttac	0.00	69.80	0.609	5.157	8.47	0.00	4.26	0.100	0.469	4.69
Y5-Phishing	0.00	61.92	0.495	4.144	8.38	0.00	4.14	0.094	0.435	4.63
Y6-OthAttac	0.00	80.00	0.374	4.729	12.65	0.00	4.39	0.033	0.342	10.48

Min Minimum, *Max* Maximum, *StdDev* Standard Deviation, *CoV* Coefficient of variation (=StdDev/Mean)
[a]The values of logarithmized series are calculated by taking logarithm after adding the value 1

determined by authors to let categories almost balanced separation in frequencies. The frequency volumes of categories are reported at Table 25.10. As CY-AllAttac variable stands for a categorized type of Y-AllAttac series, “No CA” or 0 values mean no CA reported by that firm. “CY Main CAttac” variable stands for Q16, Q18, and Q19 type CA categorizations. “CY Gen. CAttac” variable stands for Q16-20 type CA categorizations.

The IT investments variable (X1-8) categorizations at Table 25.10 represents the firms’ status relatively in terms of IT investments according to scores of generated index series. As some variables four relatively ordered categories, some may have only two relatively ordered categories. Since some of the categories has very few frequencies, category joining conducted for neighbor categories in order to get significant results. For example, “CX6-SOME” and “CX7-SecPolicy” variables

Table 25.9 Pearson correlation matrix of generated index series

	Y	Y1	Y2	Y3	Y4	Y5	Y6	X1	X2	X3	X4	X5	X6	X7
Y1-WebAttac	0.436**													
Y2-EmAttac	0.602**	0.181**												
Y3-ServAttac	0.744**	0.232**	0.366**											
Y4-VirAttac	0.502**	0.065	0.352**	0.286**										
Y5-Phishing	0.310**	−0.037	−0.017	−0.021	0.026									
Y6-OthAttac	0.465**	−0.017	0.275**	0.418**	0.431**	−0.021								
X1-TechInf	0.284**	0.150**	0.240**	0.189**	0.087	0.151**	0.026							
X2-HumRes	0.200**	0.077	0.181**	0.147**	0.147**	0.092	0.057	0.677**						
X3-FIPSIDS	0.253**	0.122*	0.114*	0.161**	0.061	0.120*	0.123*	0.410**	0.336**					
X4-AntVirus	0.163**	0.113*	0.061	0.115*	0.044	0.067	0.075	0.559**	0.207**	0.328**				
X5-Website	0.227**	0.084	0.218**	0.194**	0.146**	−0.009	0.083	0.420**	0.412**	0.459**	0.223**			
X6-SOME	0.176**	0.133*	0.045	0.111*	0.018	0.156**	−0.017	0.360**	0.303**	0.217**	0.107	0.176**		
X7-SecPolicy	0.421**	0.094	0.187**	0.370**	0.154**	0.126*	0.368**	0.304**	0.368**	0.284**	0.189**	0.266**	0.096	
X8-PolImpl	0.318**	0.190**	0.200**	0.222**	0.171**	0.112*	0.132*	0.455**	0.289**	0.351**	0.266**	0.386**	0.136*	0.331**

**Significant at the 0.01 level, *Significant at the 0.05 level

Table 25.10 Frequencies of categorized generated indexes

CX1-TechInf		f	%	*CX4-AntVirus*		f	%	*CX8-PolImpl*		f	%
1	Low	84	26.2	1	0	20	6.2	1	0	90	28.0
2	Low-medium	81	25.2	2	Low	56	17.4	2	Low	78	24.3
3	Medium-high	114	35.5	3	Medium	97	30.2	3	Medium	100	31.2
4	High	42	13.1	4	High	148	46.1	4	High	53	16.5
Total		321	100.0	Total		321	100.0	Total		321	100.0
CX2-HumRes		f	%	*CX5-Website*		f	%	*CY-AllAttac*		f	%
1	0	92	28.7	1	0	112	34.9	0	No CA	214	66.7
2	Low	197	61.4	2	Low	90	28.0	1	CA	107	33.3
3	High	32	10.0	3	Medium	75	23.4	Total		321	100.0
Total		321	100.0	4	High	44	13.7	*CY Main CAttac*		f	%
CX3-FIPSIDS		f	%	Total		321	100.0	0	No CA	283	88.2
1	0	185	57.6	*CX6-SOME*		f	%	1	CA	38	11.8
2	Low	37	11.5	1	0	311	96.9	Total		321	100.0
3	Medium	46	14.3	2	Medium	10	3.1	*CY Gen. CAttac*		f	%
4	High	53	16.5	Total		321	100.0	0	No CA	243	75.7
Total		321	100.0	*CX7-SecPolicy*		f	%	1	CA	78	24.3
				1	0	308	96.0	Total		321	100.0
				2	Medium	13	4.0				
				Total		321	100.0				

Note: The first column of each sub-table is the variable category value for some DT analysis

have only two categories since very few observations which have nonzero values are detected for them, namely 10 observations, 13 observations respectively out of 321 firms. So, these variables produce very few significant results in the analysis.

25.6.2 Differentiations of Generated Index Scores with Respect to Some Subgroups

In this part, generated index series are examined for statistically significant difference between its subgroups at the 0.05 level with respect to independent sample *t*-test. Since the sub-groups have more than 30 units, parametric statistical tests are accepted as appropriate (Table 25.11).

For the generated index series subgroups of X1-5, X7-8, Y, Y3, there is a statistically significant difference in terms of "Q4-IT Department Existence" at 0.05 level. Accordingly, firms which have IT department, have more IT investment as expected, and experienced more CA/damages for especially Y3-ServAttac, and partly Y2-EmAttac dimensions. In terms of "Q6-Firewall Usage", there is a statistically significant difference in index series of X1-8, Y, Y1, Y3. Results obtained from X1-8 series show that a higher degree of IT investing brings firewall usage. Firms which use a firewall experienced more CA/damages of, especially

Table 25.11 Differentiations of indexes in terms of IT department existence and firewall usage

	Q4-IT department existence			Q6-firewall usage		
	Not exist	Exist		Not exist	Exist	
	n = 281	n = 32	*t* test *p* values	n = 225	n = 92	*t* test *p* values
X1-TechInf	0.689	1.384	0.000	0.643	1.026	0.000
X2-HumRes	0.209	1.052	0.000	0.213	0.498	0.000
X3-FIPSIDS	1.076	2.973	0.000	0.521	3.071	0.000
X4-AntVirus	1.662	2.213	0.000	1.578	2.037	0.000
X5-Website	0.720	2.016	0.000	0.681	1.314	0.000
X6-SOME	0.080	0.364	0.187	0.024	0.313	0.011
X7-SecPolicy	0.053	1.151	0.003	0.038	0.469	0.003
X8-PolImpl	1.267	2.600	0.000	1.152	2.003	0.000
Y-AllAttac	0.152	0.684	0.007	0.121	0.407	0.001
Y1-WebAttac	0.066	0.245	0.187	0.035	0.202	0.037
Y2-EmAttac	0.143	0.543	0.054	0.129	0.309	0.079
Y3-ServAttac	0.042	0.771	0.007	0.050	0.273	0.026
Y4-VirAttac	0.080	0.304	0.143	0.084	0.143	0.391
Y5-Phishing	0.096	0.100	0.955	0.062	0.175	0.124
Y6-OthAttac	0.022	0.137	0.409	0.027	0.048	0.628

t test *p* values: Independent sample *t* test *p* values

Y1-WebAttac and Y3-ServAttac, and partly Y2-EmAttac dimensions. This result can be thought as a little bit vicious circle since CA can easily be observed by firewall, but the damages can be observed by every IT user. This is a big problem for us to measure the CA perfectly.

In terms of “CY-AllAttac”, statistically significant difference in index series subgroups of X1-5, X7-8 are observed. Accordingly, firms which have more IT investment experienced more CA/damages. Statistical tests in terms of “CY-AllAttac” and “CY Main CAttac” at Table 25.12, produces almost the same results.

25.6.3 Results of Decision Trees

In order to evaluate the determiners of CA in terms of IT investments, four scenarios (explained at Table 25.13) and three DT algorithms (J48, CRT, CHAID) are conducted. Some results of this analysis are reported at Figs. 25.1, 25.2, 25.3, 25.4, 25.5 and 25.6.

The obtained of branches of DT for determiners of CA/damages in Fig. 25.1 can be summarized as follows. (i) X5-Website with values of =<1.65, X8-PolImpl with values of >3.48 and X4-AntVirus with values of 8.37<, (ii) X5-Website with values of =<1.65, X8-PolImpl with values of >3.48, X4-AntVirus with values of <=8.37 and X3-FIPSIDS with values of >24.59, (iii) X5-Website with values of >1.65 and Q4-IT department existence with values of yes (or 1), (iv) X5-Website with values of

Table 25.12 Differentiations of indexes in terms of CA-damage experience

	CY-AllAttac			CY main CAttac		
	No CA n = 214	CA n = 107	*t* test *p* values	No CA n = 283	CA n = 38	*t* test *p* values
X1-TechInf	0.668	0.925	0.000	0.710	1.080	0.000
X2-HumRes	0.221	0.437	0.001	0.261	0.530	0.030
X3-FIPSIDS	0.970	1.822	0.000	1.150	2.028	0.001
X4-AntVirus	1.613	1.900	0.000	1.669	2.002	0.004
X5-Website	0.626	1.316	0.000	0.752	1.629	0.000
X6-SOME	0.059	0.202	0.108	0.089	0.235	0.389
X7-SecPolicy	0.057	0.371	0.009	0.117	0.493	0.091
X8-PolImpl	1.151	1.892	0.000	1.290	2.204	0.000
Y-AllAttac	0.000	0.606	0.000	0.085	1.072	0.000
Y1-WebAttac	0.000	0.247	0.002	0.000	0.694	0.001
Y2-EmAttac	0.000	0.537	0.000	0.096	0.795	0.002
Y3-ServAttac	0.000	0.340	0.000	0.000	0.958	0.000
Y4-VirAttac	0.000	0.300	0.000	0.000	0.845	0.000
Y5-Phishing	0.000	0.282	0.000	0.092	0.106	0.858
Y6-OthAttac	0.000	0.098	0.088	0.011	0.196	0.192

>1.65 and Q4-IT department existence with values of no (or 0), X8-PolImpl with values of >2.35 and X5-Website with values of >10.16. The predict performance of CA (F = 0.59) is higher than the no CA (F = 0.86) firms, because of less F value. General accuracy and Kappa values of prediction can be thought moderate or satisfactory.

Q4, Q31, X5, and X8 are used in the model in Fig. 25.2. General accuracy and Kappa values of prediction can be thought moderate, but a little bit less prediction performance is observed than the previous model.

X5 and X8 are used in the model in Fig. 25.3 and prediction can be thought moderate, but less prediction performance than previous models.

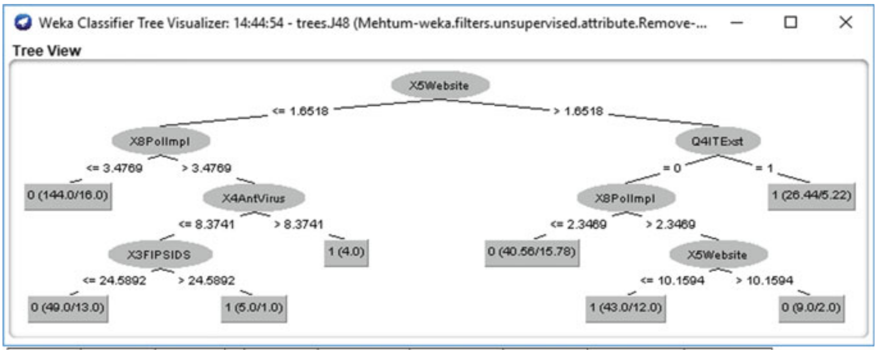
X5 and X8 are used in the model in Fig. 25.4 and prediction can be thought moderate, alike with at Fig. 25.3.

X5 and X8 are used in the model in Fig. 25.5 and prediction can be thought almost moderate.

Table 25.13 Scenarios of the DT modellings

Scenario	Explanation
Scen1	The model is conducted with dependent categorical variable CY, and independent variables Q4, Q6, Q31, Q32, and continuous variables X1-8, with using all the data (321 unit)
Scen2	The model is conducted with dependent categorical variable CY, and independent variables Q4, Q6, Q31, Q32, and ordinal variables CX1-8, with using all the data (321 unit)
Scen3	The model is conducted like variables in Scen1 with using 171 firms, answer questions of Q6, Q9.1, Q10 as yes, in order to model the determiners of the CA for the firms who may easily detect the attacks via software
Scen4	The model is conducted like variables in Scen2 with using 171 firms, answer questions of Q6, Q9.1, Q10 yes

Note: First two subcategories of "Q31-Revenues" variable is merged and last two subcategories of "Q32-Personnel" variable is merged in order to get away from the small volume categories

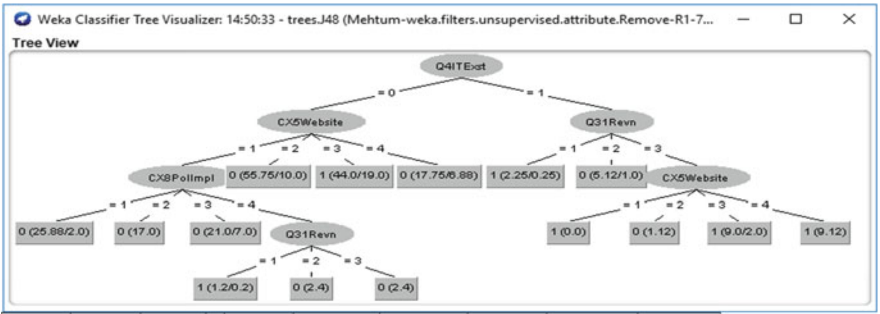


	A (0)	B (1)		Recall	Precision	F	Accuracy	E(T)	Kappa
A' (0)	196	47		0.9159	0.8066	0.8578	0.7975	0.5857	0.5113
B' (1)	18	60		0.5607	0.7692	0.6486			

Fig. 25.1 DT of J48 Algorithm and Scen1

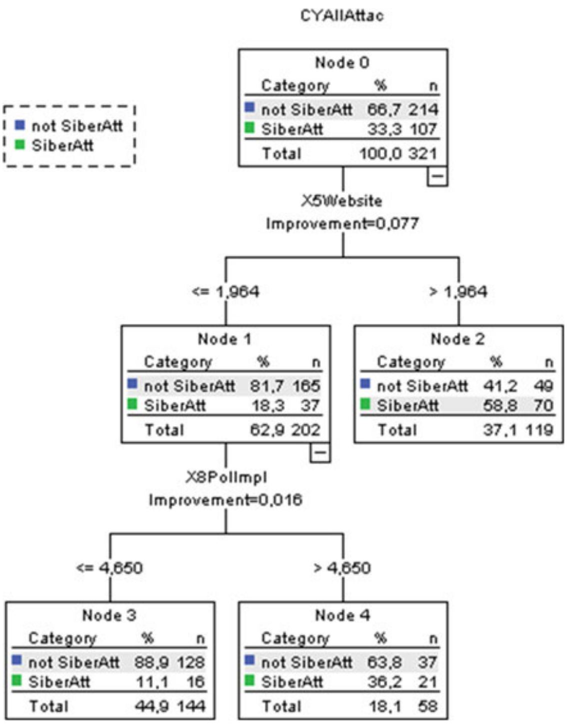
X5 is used in the model in Fig. 25.6 and prediction can be thought moderate, alike with at Figs. 25.3 and 25.4.

Scenario 1–2 results with using J48/CRT/CHAID algorithms of DT models are comparatively reported at Table 25.14 and Figs. 25.1, 25.2, 25.3, 25.4, 25.5 and 25.6. IT investments of X5-Website and X8-PolImpl are the primary CA-damage determiners, and then Q4-IT department existence, Q31-Revenues, X4-AntVirus, X3-FIPSIDS investment can be observed respectively. Scenario 3–4 results which results are not presented showed the IT investments of X5-Website and X8-PolImpl are alike primality in CA-damage determiners, with X1, X2, Q31, Q32, and rarely X3, X4. Scenario 3–4 results represent the 171 firm data who may easily detect the attacks via its software.



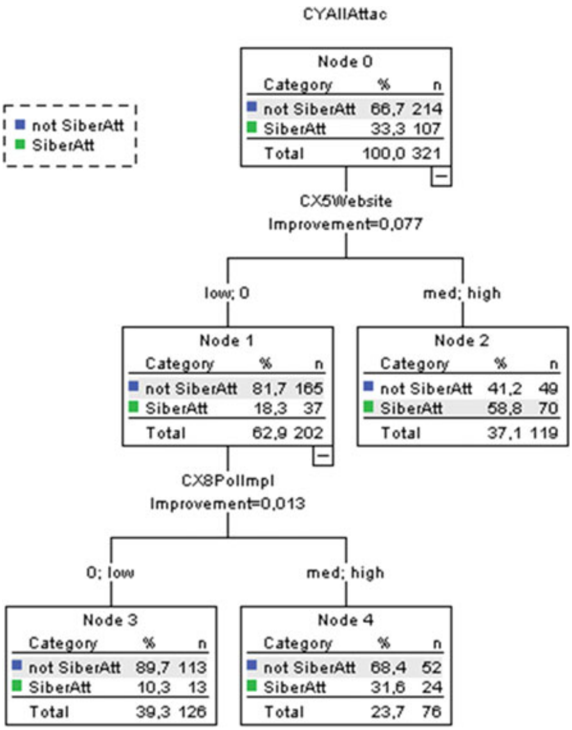
	A (0)	B (1)		Recall	Precision	F	Accuracy	E(T)	Kappa
A’ (0)	187	45		0.8738	0.8060	0.8386	0.7757	0.5742	0.4732
B’ (1)	27	62		0.5794	0.6966	0.6327			

Fig. 25.2 DT of J48 Algorithm and Scen2



	A (0)	B (1)
A’ (0)	165	37
B’ (1)	49	70
Recall	0.7710	0.6542
Precision	0.8168	0.5882
F	0.7933	0.6195
Accuracy	0.7321	
E(T)	0.5431	
Kappa	0.4136	

Fig. 25.3 DT of CRT Algorithm and Scen1



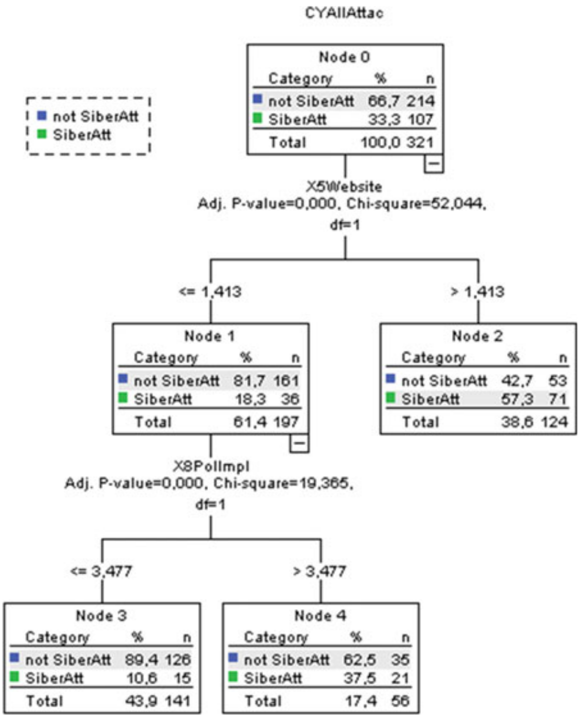
	A (0)	B (1)
A' (0)	165	37
B' (1)	49	70
Recall	0.7710	0.6542
Precision	0.8168	0.5882
F	0.7933	0.6195
Accuracy	0.7321	
E(T)	0.5431	
Kappa	0.4136	

Fig. 25.4 DT of CRT Algorithm and Scen2

25.7 Conclusion

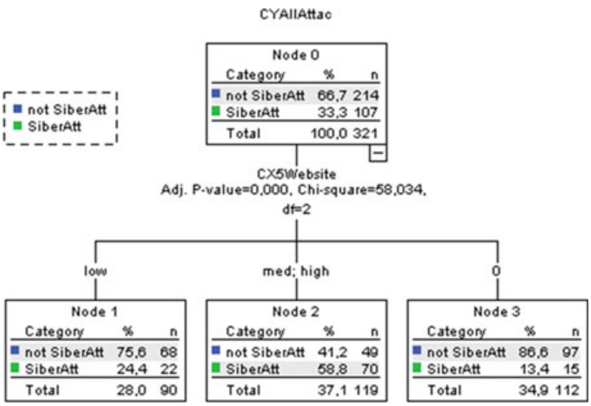
The objective of the study is to evaluate the relations and determiners of CA-damages in terms of IT investments from the perspective of firms' economics, and reveal the results to investors, decision makers, and researchers. This study also shows MCDM methods/TOPSIS applicability on generating index scores for representative of so many variables in order to use some statistical tests and DT analyses with comparing the variety of algorithms/scenarios' results instead of regression analyses which needs much more assumptions that must be satisfied. The analysis results represent that Zonguldak firms that have more than 20 personnel but for only 2016 which restricted us for more information of the other years and may be restricted for getting robust results from (logistic) regression analysis then urged us to use other analysis such as DT.

According to results, all the dimensions of IT investments are correlated with CA severities, since all CA needs IT in order to survive. X7-SecPolicy component of IT has the highest correlation with CA. Firms that use firewall usage, observe more CA maybe since they have more ability to detect CA, accordingly, we cannot objectively get information about the CA determiners among the firms but about CA damages.



	A (0)	B (1)
A’ (0)	161	36
B’ (1)	53	71
Recall	0.7523	0.6636
Precision	0.8173	0.5726
F	0.7835	0.6147
Accuracy	0.7227	
E(T)	0.5379	
Kappa	0.4000	

Fig. 25.5 DT of CHAID Algorithm and Scen1



	A (0)	B (1)
A’ (0)	165	37
B’ (1)	49	70
Recall	0.7710	0.6542
Precision	0.8168	0.5882
F	0.7933	0.6195
Accuracy	0.7321	
E(T)	0.5431	
Kappa	0.4136	

Fig. 25.6 DT of CHAID Algorithm and Scen2

IT investments of X5-Website and X8-PolImpl can be accepted as primary CA-damage determiners, and then Q4-IT department existence, Q31-Revenues, X4-AntVirus, X3-FIPSIDS investment can be observed.

Table 25.14 Comparison of some DT model results

		Scenario 1									Scenario 2					
Algorithm		J48				CRT		CHAID			J48			CRT		CHAID
Variable	Branch[a]	1	2	3	4	1	2	1	2	1	2	3	4	1	2	1
X3-FIPSIDS	0-Low															
	Medium-High	✓														
X4-AntVirus	0-Low	3														
	Medium-High		✓													
X5-Website	0	1	1				1		1						1	
	<1.41, 1.65, 1.96	1	1				1		1							
	1.41, 1.65, 1.96<			1	1	✓		✓								
	Low			1	1	✓		✓							1	
	Medium			1	1	✓		✓		✓			✓	✓		✓
	High			1	1	✓		✓					✓	✓		✓
	=<1.65				✓	✓		✓								
X8-PolImpl	2.35<				3											
	3.48; 4.65<	2	2		3		✓		✓							
	Low	2	2		3		✓		✓							
	Medium	2	2		3		✓		✓						✓	
	High	2	2		3		✓		✓		2				✓	
Q4-IT department existence	Not Exists				2					1	1					
	Exists			✓								1	1			
Q31-Revenues	=<500										✓	✓				
	1000<												2			
Some Goodness of Fit Measures	F0, F1	0.86, 0.65				0.79, 0.61		0.78, 0.61		0.84, 0.63				0.79, 0.62		0.79, 0.62
	Accur, Kappa	0.80, 0.51				0.73, 0.41		0.72, 0.40		0.77, 0.47				0.73, 0.41		0.73, 0.41

[a]The branches presented when the conditions satisfied, while the numbers in the table show the branch sequence

CA, as well as all over the world shows the effect in Zonguldak. In 2016, 516 effective CA were observed in our province, and due to the attacks, 143 days of service disruption occurred in the companies (Öztürk et al., 2017). Analysis results showed that CA-damage increased as IT investments increased. This increase can be thought natural as investments have increased the number of devices that can be attacked. The lack of widespread use of firewalls and IPS/IDS by companies indicates that CA is not fully understood by the companies. The security policies' application is also important as much as its preparation. The measures are taken on the server and other service devices generally do not prevent the violation itself. Security policy in the pre-attack, during the attack and after the attack is planned to attack even if exposed to the effect is reduced. In corporate networks, the weakest link in the chain is mostly the ultimate users. Anti-virus software is especially important in terms of cybersecurity because it tries to shut down this deficiency in the ultimate user. Backup is also important for cybersecurity because it reduces the negative impact of many CA-damage. Getting a proper backup could minimize data loss. Firms tend not to speak their status even if their data is stolen as a result of CA-damage. Therefore, it is estimated that real pecuniary losses are much higher than those revealed.

As mentioned, the lack of widespread use of firewalls/IPS/IDS by companies results in non-detecting/observing CA which is the main limitations of this study. The other limitation of the study is, the data was obtained for only 2016, accordingly, very few CA observations inhibit us to get strong/good results from the analysis. Thus, the results of our study should be taken into consideration with these limitations, and in future studies, these limitations should be removed and the data sample may cover the whole country or more than one country.

Appendix 1 Survey Questions/Items, Their Scales and Their Indexes Belong to

Q	I	Section 1. Computer and Internet Status	Scale
Q1	X1	How many computers are there in your company?	Numeric
Q2	X1	Do you have internet access in your company?	No/Yes
Q3	X1	Is there a server in your company? (Virtual servers will be included.)	No/Yes
		Q3.1: Total	Numeric
Q4		Is there an IT Department in your firm?	No/Yes
	X2	Q4.1. The average number of employees working in the IT department in 2016	Numeric
	X2	Q4.2. Expenditure of the IT Department in 2016	Numeric
Q5	X2	Do you receive external support for IT duties?	No/Yes
		Section 2. Internet Security	
Q6		Do you use a firewall?	No/Yes
Q7		What kind of firewall are you using?	
	X3	Q7.1. Open source firewall (It is the software that allows the user to change the software.)	No/Yes
	X3	Q7.2. Box solution firewall (A hardware-based network security system that controls incoming packet traffic to the network.)	No/Yes
	X3	Q7.3. Services offered by companies such as telecom, ttnet	No/Yes
Q8		Do you use anti-virus software on your computers?	
	X4	Q8.1. Licensed antivirus program	No/Yes
	X4	Q8.2. Unlicensed (or free) anti-virus program	No/Yes
Q9		Do you use an antivirus program on your server?	
	X4	Q9.1. Licensed antivirus program	No/Yes
	X4	Q9.2. Unlicensed (or free) anti-virus program	No/Yes
Q10	X3	Do you use IDS-IPS and DDOS attack blocker in your company?	No/Yes/n't know
		Section 3. Existing Applications in the Initiative (Please answer the questions in this section with reference to the year 2016.)	
Q11		Do you have the following applications in your company?	
	X5	Q11.1 Website	No/Yes
	X5	Q11.2. Mobile applications	No/Yes
Q12	X5	Has your company received a product/service order in 2016 through its website or mobile applications?	No/Yes
Q13	X5	What is the share of your company's orders over the website or mobile applications in 2016?	Numeric (%)
Q14	X3	Is there a privacy seal or certificate (SSL, TSL, etc.) related to the security of your website or mobile applications?	No/Yes
Q15	X5	Do you have an institutional mail address? (xxxx@tuik.gov.tr, xxxxx@bakka.gov.tr, xxxx@beun.edu.tr)	No/Yes
Q16		Has there been any CA on your mobile apps or website?	

(continued)

	Y1	Q16.1. Number of attacks	Numeric
	Y1	Q16.2. How many days were out of service in 2016	Numeric
	Y1	Q16.3. Your financial loss in 2016	Numeric (TL)
Q17		Have you been attacked by e-mail?	
	Y2	Q17.1. Number of attacks	Numeric
	Y2	Q17.2. How many days were out of service in 2016	Numeric
	Y2	Q17.3. Your financial loss in 2016	Numeric (TL)
Q18		Have you had a CA on your server?	
	Y3	Q18.1. Number of attacks	Numeric
	Y3	Q18.2. How many days were out of service in 2016	Numeric
	Y3	Q18.3. Your financial loss in 2016	Numeric (TL)
Q19		Have you been cyber-attacked by malicious software such as Computer Viruses, Trojan Horse, Worm, for personal reasons (such as using someone else's password, not behaving carefully)?	
	Y4	Q19.1. Number of attacks	Numeric
	Y4	Q19.2. How many days were out of service in 2016	Numeric
	Y4	Q19.3. Your financial loss in 2016	Numeric (TL)
Q20		Has your company been attacked by phishing attacks or social engineering?	
	Y5	Q20.1. Number of attacks	Numeric
	Y5	Q20.2. How many days were out of service in 2016	Numeric
	Y5	Q20.3. Your financial loss in 2016	Numeric (TL)
Q21	Y	Did you experience data loss due to hard disk corruption?	No/Yes
Q22		Did hard drive failure cause economic damage?	No/Yes
	Y	Q22.1 Your financial loss in 2016	Numeric (TL)
Q23		Did it cause damage to the following reasons?	
		Q23.1. Using unlicensed software	No/Yes
		Q23.1.1. Economic Damage	Numeric (TL)
		Q23.2. Industrial espionage	No/Yes
		Q23.2.1. Economic Damage	Numeric (TL)
Q24	X6	Do you have a CA response team (SOME)?	No/Yes
Q25	X6	Are you planning to install the SOME unit?	No/Yes
Q26		Is there a planned information and communication technology (ICT) security policy that is formally defined and regularly reviewed at your initiative?	No/Yes
Q27		Which of the following risks is included in your IT security policy?	
	X7	Q27.1. Corruption or loss of data due to an unexpected event or attack	No/Yes
	X7	Q27.2. Rerouting password to another site	No/Yes

(continued)

	X7	Q27.3. Unintended data disclosure	No/Yes
	X7	Q27.4. Failure to provide IT services due to CA	No/Yes
Q28		Are you affected by the following events related to IT security?	
	Y6	Q28.1. Failure to provide IT services due to data loss or loss due to hardware or software errors	No/Yes
	Y6	Q28.2. Rerouting the password to another site	No/Yes
	Y6	Q28.3. Unintended data disclosure	No/Yes
	Y6	Q28.4. Failure to provide IT services due to CA	No/Yes
	Y6	Q28.5. Corruption or loss of data due to malware or unauthorized access	No/Yes
Q29		Which of the following internal security methods has been applied by your company?	
	X8	Q29.1. Powerful password and authentication	No/Yes
	X8	Q29.2. Authentication using hardware (e.g. Smart cards)	No/Yes
	X8	Q29.3. User identification and verification by biometric methods	No/Yes
	X8	Q29.4. Data backup in different locations	No/Yes
	X8	Q29.5. Activities on my list for analysis of security incidents	No/Yes
		Section 4. The Expenditure of your Firm for Web Site and Mobile Applications and the Economic Size of the Firm	
Q30		Did you make any spend in 2016 for website/mobile applications?	No/Yes
	X5	Q30.1. Total expenditure	Numeric (TL)
Q31		What is the turnover of your company in 2016? (100,000 TL or less; Between 100,001–500,000 TL; Between 500,001–1,000,000 TL; 1,000,001 TL)	Ordinal (checkbox)
Q32		What is the number of personnel working in your company as of November 2016? (1–19; 20–49; 50–99; 100–249; 250 or more)	Ordinal (checkbox)

I: Survey Questions, used for calculations of called index series

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Chapter 26
Copyright and Intellectual Property in Digital Business: Issue of Protection and Retrieval of Investment in Intellectual Creation

Badar Alam Iqbal and Arti Yadav

Abstract The aim of this chapter will be to explicate about the Copyright in Digital Business. The study will begin with highlighting the overview of Copyright law and digital business scenario. The chapter will further scrutinize the issues and challenges associated with the Copyright in Digital Business. The present study hold a descriptive methodology by adopting secondary data from various organizational resources. The Intellectual Property has voyage to the internet both in substance and as a concept which has become imperative to the success of digital businesses. With regard to the Copyright on digital media, the holders are in quest of protection of their rights and aim to retrieval of their investment in intellectual creation. The study will try to find out whether current law and practice provide enough motivation for the supreme quantity and premier quality of original works to be produced and consumed in the present digital world. Further, it will try to find out the level of difficulty in terms of how the current copyright regime is competent enough to harmonize between private incentives and social benefits.

26.1 Introduction

Intellectual property (IP) related legal environment has developed with growth of technology. Intellectual property refers to the creations of the mind, such as inventions; literary and artistic works; symbols; names and images used in commerce' (WIPO, 2011). They play different roles based on their structure. Patents and copyright leads to endorse product innovation and the conception of new work

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mechanism. Design rights leads to promote enhancement in the appearance and sense of consumer goods. Trademarks, on the other hand, protect brand reputation and consumer information (Productivity Commission Inquiry Report, 2016). Filing of Patents across the world has reached 3.17 million, showing a growth of 5.8% since 2016; Trademark to 12.39 million, showing a growth of 26.8% on 2016; Industrial design over 1.24 million with China at the top of global growth in IP filings (WIPO, 2018). Global reach of the Internet facilitate digital content to be immediately available around the world. Cisco (2019) estimates that global IP traffic will increase threefold over the next 5 years making it grow at a Compound Annual Growth Rate (CAGR) of 26% from 2017 to 2022. Therefore, for the digital content it highlights the significance of copyright as an incentive mechanism for the formation and broadcasting.

The evaluation of Printing Press has lead to the emergence of copyright for the concerned creative work, music, theater and art. Further, sound found on tangible media and visible over radio waves is also included in the rights. However, several concepts connected with present rights are not simply convenient to a digital world (Rao, 2001). It is basically a form of government regulation that offers producers of creative works with a restricted monopoly to persuade and encourage the spreading of precious intellectual supplies to the consumers. It makes way for its persistence as a modern legal framework with additional required changes. Since past, there has been a thoughtful modifications in the approach creative works are shaped and consumed with the introduction of the digital age. Therefore, it leads to various challenges for copyright in this new environment in terms of role, structure and function of copyright law (Bond, Paramaguru, & Greenleaf, 2007; Samuelson, 2007; Weatherall, 2011). Cultural, social and economic repercussions for a large number of stakeholders has lead to risen the need for different and challenging reforms in this area (Patry, 2012).

In present century, the concept of e-commerce, e-business and digital economy is not new, but as of today they hold an important place across worldwide economies (Iqbal & Yadav, 2019). The escalating use of both computers and information communication technology has given rise to a digital economy, making changes in the way products are created, the character of products and their circulation. Since the beginning of trade in goods and services in the digital platform, the intellectual property rights have become more vulnerable to violation devoid of ample protection of return to the creator of knowledge. Through putting a ceiling on replication and copying, monopoly power is granted, however the social costs of monopoly power may be counterbalance by the social benefits of higher levels of creative activity buoyant by the monopoly earnings (Khemani & Shapiro, 1993). Consequently, IP rights and copyright law is exemplified by the equilibrium it asks for to attain between private incentives to engage in creative activity and the social benefits obtained from the extensive use of creative works. However, in recent years, that balance has been rigorously challenged because of the introduction of the digitization of creative content and the swift pace of technological advance (CBO, 2004). Therefore, the aim of this chapter will be to explicate about the Copyright in Digital Business. The study will begin with highlighting the overview of Copyright law and digital business scenario. The chapter will further scrutinize the issues and challenges associated with the Copyright in Digital Business and will suggest measures for the retrieval of investment.

26.2 Intellectual Property and Copyright Law: An Overview

Intellectual Property rights are allied with intangible property rights that require to be abridged to tangible form before it can meet the criteria for IP protection. IP rights are based on national or regional laws of country to which the law applies. The pertinent law of a region confines the duration of patents, design, new varieties of plants, topographies of integrated circuits and copyright/related rights, however it permits unrestricted duration for trade secrets, trademarks and geo-graphical indications. The holder of an IP right, based on the type of right and concerned region, may be able to trade, consent others to use, mortgage, abandon, pass on to legal heirs, give, or otherwise dispose of the IP right (ICC & WIPO, 2011). The key types of IP rights for e-commerce can be categorized in as, Patents, Trade Secret, Copyright and Trademarks (Bowyer, 1996). Patents, copyrights and trademarks are the property rights that make the owner to implement a monopoly on the employability of the article for a particular period. They are the rights which reward imagination and human effort leading to the development of creativity or innovation. Whereas, according to WIPO, a trade secrets comes under the bracket when any information that is not usually acknowledged to the relevant business circles or to the community; which provides benefit to its holder. This profit must derive exclusively from the information that it is not normally found and it should be because of reasonable efforts to uphold its secrecy.

According to World Intellectual Property Organization, Copyright laws grant authors, artists and other creators security for their literary and artistic creations, generally referred to as "works". Works covered by copyright include, but are not limited to: novels, poems, plays, reference works, newspapers, advertisements, computer programs, databases, films, musical compositions, choreography, paintings, drawings, photographs, sculpture, architecture, maps and technical drawings. Infringement of Copyright is a criminal offense which can lead to legal action and carrying a punishment of sentence or huge fines. If there is no copyright law, there would be little motivation for persons of creative ability to follow their inventive liking. In reality, it would be unfeasible in most cases for persons to do so without realizing some monetary return from their efforts. Copyright basically provides two types of rights, Economic rights in terms of financial reward and Moral rights in terms of non-economic interests of the author.

Figure 26.1 shows the total application of different intellectual property rights around the world. There is no International Copyright law as each country has created separate law for them. However, 180 countries around the world have

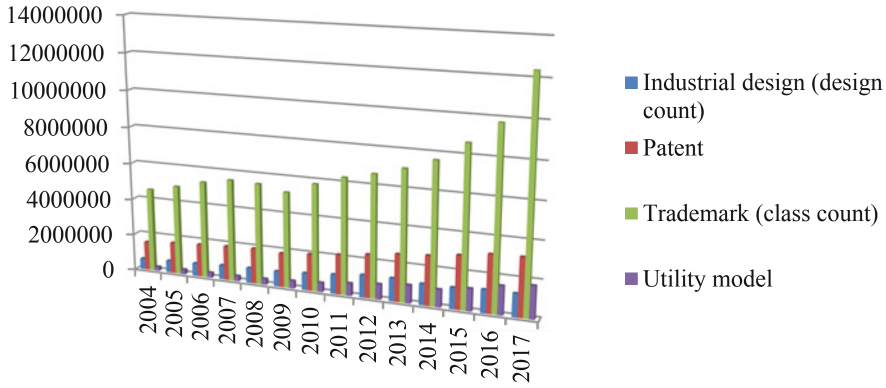

Fig. 26.1 Total applications of intellectual property rights around the world. Source: WIPO statistics database

Table 26.1 International copyright treaties around the world

International copyright treaties	Country of formulation	Governing body
Berne convention	Berne	WIPO
Beijing treaty	Beijing	WIPO
Geneva convention	Geneva	WIPO
Brussels convention	Brussels	WIPO
Marrakesh treaty	Marrakesh	WIPO
Rome convention	Rome	WIPO
WCT	Geneva	WIPO
WPPT	Geneva	WIPO

Source: Saraswat and Chaturvedi (2017)

approved a treaty known as the Berne Convention, managed by the World Intellectual Property Organization to set minimum standards for the fortification of the rights of the creators around the world.

With the revolution in digital technology, the intellectual property issues has become too crucial, leading to the need for introduction of new rules and regulations in the existing World Intellectual Property Organization (WIPO) international copyright treaties. Therefore, it lead to the introduction of WIPO Copyright Treaty (WCT) and WIPO Phonogram and Performance Treaty (WPPT) and various other treaties (Table 26.1). According to OECD (2008 and 2011) Seoul Declaration for the Future of the Internet Economy and the Council Recommendation on Principles for Internet Policy Making effective and efficient protection of intellectual property rights plays an imperative role in stimulating innovation and promoting the development of the digital economy (OECD, 2011).

26.3 Intellectual Property and Its Alliance with Digital Business

On demand availability of computer system resources, especially data storage and computing power provided an opportunity to utilize shared resources leading to optimization of business operations in the technologically motivated global economic environment. It comprises of access to databases for the businesses, access to software that is important for decision making and contribution to knowledge and information sharing (Rahman & Iqbal, 2019). Digital business scenario revolves around internet as a conventional communications medium leading to a new commercial business reality. Figure 26.2 shows internet usage around the world for the year 2018. With the introduction of electronic business many persons have started looking at the Internet more than as a basic utility. Due to digitalization there has been large-scale and comprehensive revolution across various aspects of business, leading to conception of opportunities for value creation and dealing with the risk involved. Digitalization further provides opportunity to organizations to market themselves domestically, nationally and internationally at comparatively low cost, getting previously unreachable consumers (Hargreaves, 2011). Digital technology significantly cuts the cost of replication, sharing and altering the content, which has directed towards additional copyrighted content and to a great extent wider usage from past and the further resulting in to the accessibility of pirated content.

Though digital technology will alter most of the organizations, still a number of issues are involved like the swiftness of shifting of consumer outlook, cultural transformation, outmoded regulation, and recognizing and approaching the precise expertise (World Economic Forum, 2016). Digital technology is fundamentally restructuring and distracting the foundations of business through creating opportunities for startups, however making it hard for organizations that are having hard time to keep pace innovating. For example, Alibaba, started by Jack Ma in 1999 with a small share, in 2016 this e-commerce giant served 367 million customers and generated sales of over 153 billion Yuan (Handley, 2017).

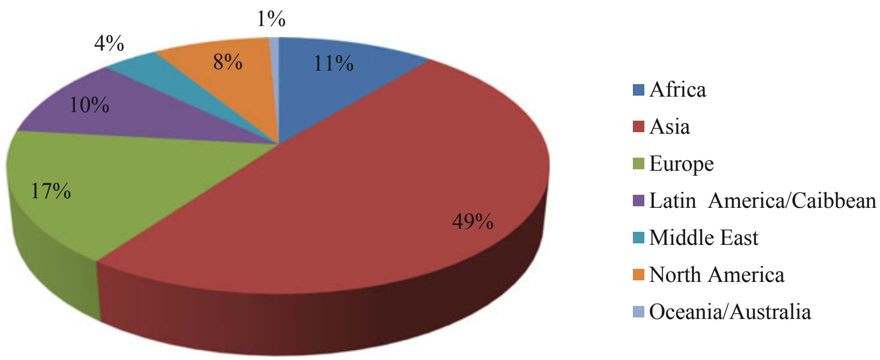

Fig. 26.2 World internet usage 2018. Source: Internet World Stats (2018)

Protecting the rights of the owners, creators and public interest use is the balance that a copyright system looks for in the digital environment. Copyright protects the creative content across the Internet and information leading to the subject matter of e-commerce. With the introduction of the rapid digitization and unauthorized copying, replication and distribution even sharing of larger files has become very easy which made the right owners noteworthy sufferers. Another issue in digital area which needs to be addressed is about the situations under which an Online Service Provider should be held responsible for infringing actions commenced by the subscribers. This issue has been dealt by different jurisdictions either through legislative provisions or judicial pronouncements (Digital Millenium Copyright Act, 1999).

For the profitability of an organization technology is one of the main players. From invention to innovation i.e., the commercialization of new technology is substantial source of income. For different people innovation is understood differently as the world is dynamic and the worldly is innovative. In the present time of globalisation and competition, innovation is a mandatory requisite at each and every level for a successful organization (Iqbal & Rahman, 2018). Strong appropriability establishment or the ownership of complementary assets, or preferably both are the need of an organization to get benefited from the organization (Ceccagnoli & Rothaermel, 2008; Teece, 1987). Recently an increasingly large number of organizations in various industries have implanted digital technology in their products, services, processes and business models leading to widening of their technology bases. As organizations in different industries are directing into the same technology area, new matters related to how intellectual property (IP) should be managed arise. Patents, Copyright, design rights and trademarks as main intellectual property rights motivate innovation by offering a time bound return on innovative investment. This leads to lessen the risk in inventing and creating new products and services, by inspiring innovation, competition and stronger economic growth. The Intellectual property right system also supports follow on innovation as information about technology is spread through sharing of the complete technical workings of any patented invention (Hargreaves, 2011).

Further, growth of innovation may be hindered if unduly inflexible applications of copyright law facilitate rights holders to obstruct potentially vital novel technologies. Also, the interests of rights owners have put them in conflict with developers of video recorders and web search engines. As data farming becomes routine in systems across the economies, from the management of transport to the administration of public services, copyright issues become ever more significant as potential obstructions. In these conditions, copyright and other intellectual rights in its current form symbolizes a barrier to innovation and economic opportunity (Griffin, 2017). However, implementing IP and Copyright protection does not help to generate an instant return in comparison to selling a product but it significantly helps to limit possible or additional losses if not implemented (Nasir, Ponnusamy, & Lee, 2007). Therefore, policy creators have taken the outlook that consumers should have the flexibility to make reasonable uses of legally obtained copyrighted content in the digital epoch. Most of the economies around the world have copyright limitations and exceptions frameworks to permit certain unlicensed uses of copyrighted materials, for instance, for personal use, review, criticism, parody, educational purposes, etc. to make certain that the genuine interests of rights holders are valued and respected (Broadely, 2019).

26.4 Issues Associated and Retrieval of Investment with Copyright and Intellectual Property in Digital Business

Digital technology has revolutionized most of the industries in a positive manner, however, a few of them have been hit as hard such as the content industries in terms of the producers of music, movies, television programs, software, video games, books, periodicals etc. as it has made it easier than ever for consumers to get access to content without authorization or without paying for it. Also, pirated content is mostly pleasing for people who are looking for sources of entertainment that are not accessible where they are in licensed and legal forms (Castro, Bennett, & Andes, 2009). Digital piracy report shows that global piracy rose by 1.6% over the course of 2017, showing that 300.2 billion visits to piracy websites across music, TV and film, publishing, and software. It further shows that more than a third of these visits were to piracy sites hosting television content (106.9 billion) which is more than music (73.9 billion) and film (53.2 billion) sites. Accordingly, the USA is at the top of the list as making the most visits to piracy sites (27.9 billion), followed by Russian Federation (20.6 billion), India (17 billion), Brazil (12.7 billion), Turkey (11.9 billion), Japan (10.6 billion), France (10.5 billion), Indonesia (10.4 billion), Germany (10.2 billion) and United Kingdom (9.0 billion) (MUSO, 2018). The data in itself shows that the problem today is the quantity of information that is dispersed by the Internet. For some it may be a victimless crime but piracy has a negative impact on the economy. It is becoming hard to control individual preference as much of what Internet piracy controls depends on an individual's personal ethical beliefs. According to the Online Copyright infringement tracker survey report, it has been found that the main cause for committing copyright infringement is that it is free, convenient and quick. Based on this scenario various anti-piracy organizations and digital goods producers have under-taken different approaches to alleviate piracy such as technology-based approach in terms of digital rights management, legal approach in terms of IP rights and educational approach in terms of providing information.

Productivity has been seen as the key driver of long term economic growth. Recently innovation leads to the majority of productivity growth and job creation, mostly by small and young firms (OECD, 2017). Intellectual property rights provides their holders the right to stop others from using that particular product or service, however there is a possibility that parties involved may unjustifiably exercise market power. This may lead the holder of IP rights to pull out undue royalties from IP licenses with unfavorable effects for innovation and eventually affecting the consumers (Harper, Anderson, McCluskey, & O'Bryan QC, 2015). Digital form assets or work are easy to be replicated and circulated in different economies around the world with exact quality and less cost. Further, the rules and regulations about intellectual property rights differs from country to country, which makes it further hard as what may be an illegitimate use of digital intellectual property in one country may not be considered unlawful in other country making it a world of jurisdictional issues. For authors and other right holders, the challenge in the digital era is to preserve their right to create new works and apply new technologies to make it available to the consumers in tune with protecting themselves illegal competitors. Also, the creation of social media added to the issue as the concept of it revolves around sharing which makes it difficult to scrutinize millions of infringed photos, videos, and other materials (Lundell, 2015). The intellectual property law is continuously changing and renewed to make it in par with new technology, case law and even industry based negotiations. So, if there are concerns with digital work, it can be complicated to forecast the result of the probable legal actions.

Intellectual property can lead to creation of long term value, not like assets whose value depreciates overtime. It guards value of brands, innovations, design and also leads to increment in its value. For instance, the value of trademarks is mainly depends without any upper cap on how well the organization is working. It has been found that registered trademarks not only protect the presented value in the brand but also add to its enhancement as well (Damodaran, Suraj, Sundaram, & Yerramilli, 2016). Design Registration is also one of the ways to protect brand value, therefore legal protection of the same increases the value of the business (Tucci, 2015). Further, IP rights in the form of Patents can create inherent worth for an organization without depending on its performance and perception of its product or service in the market (Pentheroudakis, 2015). Intellectual Property has features of an asset in a way that investment in developing and protecting intellectual property can be recovered in different forms as it can as well be sold like other properties. Presently, investors evaluate businesses on the basis of brand protection, innovativeness and uniqueness of the product design. For an organization to keep its relationship with various participants such as resellers, distributors, shareholders etc. intact, needs to protect its intellectual property investments. Further, intellectual property also helps in marketing of the product by making it stand out in terms of protected appearance and product design. Also, in the recent years, there has been an increase in the research and development costs allied with investments required for the introduction of the new technology or innovative ideas (Saha & Bhattacharya, 2011). Therefore, Digital world requires a strong IP rights protection system because of the following reasons:

- Rapid technological changes
- Advance skills oriented
- No Geographical restrictions
- Shortening of the Product life cycle
- Highly Competitive and Software based
- High Research and Development and marketing costs

Various organizations overlook adopting Copyright protections as the remedies seen as limited, lengthy legal procedures and the cost involved, based on their evaluation between costs and benefits. However, looking at the current scenario, in order to preserve their future interest in the incident of any likely infringement, it has become like something which must be approved (Nasir, Ponnusamy, & Lee, 2007). Also some of the studies have verified that the impact of IP rights protection over the economic growth depends of the development level in case of small and high income economies and the relationship is positive and significant. IP rights protection further persuade innovation in the economies with high income, and the technological exchanges in the small income nations (Ciociu, 2011). Therefore, IP rights should not be seen as just a legal issue but should be seen as a component of the overall business strategy. It should be used as a tool to become and stay competitive in the economic environment (WIPO, 2011). Policies by government towards reducing digital piracy support technological innovation. Government of an economy should not confine innovations that may unintentionally aid illegal activity for instance as cryptography, networking protocols and multimedia encoding, also neither should it restrict innovations that can reduce illegal activity like digital rights management, content identification and filtering, and network management because restricting such type of innovation can impede the growth of technology and retrieval of the investment.

26.5 Conclusion

In digital economic environment, the legal framework should support innovation to maximize opportunities in terms of the provisions that can manage the range of acceptable uses of copyrighted matter. Internet in its present form is out of the reach of law in various issues therefore making it evident to question that whether IP rights and copyright laws are surprised by the development of technology and raising the importance of digital environment. Innovation plays a crucial role to develop the competitive edge in both developed and developing economies making intellectual property strategies a significant factor for simulating economic growth and development. IP rights can lead to growth of human understanding with the help of socially valuable innovation which otherwise would not have taken place. Various economists also showed that the accumulation of knowledge is also one of the motivating forces behind long term economic growth of countries (Romer, 1986). Though, IP rights can be a costly affair, if are not regulated in a proper manner. For instance, IP rights restrains competitors from generously using an inventor's technology, however over-protection can suppress healthy competition by reducing innovation and charging undue prices. Furthermore, IP rights and copyright can restrain the development of knowledge by restricting subsequent innovation. Also, the question of the hour is that without hindering freedom of expression and the free movement of information, how IP law can should work to reward the creator. IP rights comprise a first accessible assurance and value that can be find out by the investors and permit innovators to come up to investors as they have an essential power that the investor is able to estimate with in terms of protected asset which can be integrated in a business plan. Without a doubt, the present form of IP and copyright laws do offer guards Copyright owners but it has some shortcomings. The broadness of Internet demands a more hopeful association with other jurisdiction and close collaboration with the international organizations. Further, people must be informed regarding IP and copyright protection to avoid any unlawful application.

Therefore, in order to restrict IP rights and copyright infringement, there should be more clearly defined boundaries for organizations. WIPO treaties around the world are the steps towards this direction and the adoption of copyright in the year 1996 is an example of the same. The outcome is an absolute and well thought-out legal tool able to avert, verify and inhibit detrimental actions against IP rights. However, with the invention of digital platform, the idea should be to create new opportunities without destroying the present structure in terms of the protection of digital content. So, as to maintain the privacy and cyber security in the digital era, regulations in terms of data processing at the local level, data transfer permission from the government, advanced software to protect data theft are some of the measures. Further, in various economies there has been laws that are prejudiced in terms of data supply to other economies. Such kind of strategy is also helpful in the protection of IP rights. In the present dynamic environment, it is quite difficult to determine an apt policy approach which should be in sync with the technological change, evolving at the same pace in terms of legislative and regulatory framework. In the end, it could be suggested that a globalized IPR regime should be formed with the participation of most of the economies around the world, building up a competitive and widely acceptable for digital environment. Eventually, the rationale is to make the internet economically feasible for the advantage of the information society and this would fundamentally depend on the effectively resolution of the issues associated to IP rights.

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Chapter 27
The State of the Art in Blockchain Research (2013–2018): Scientometrics of the Related Papers in Web of Science and Scopus

Guzin Ozdagoglu, Muhammet Damar, and Askin Ozdagoglu

Abstract Blockchain is relatively a new technology that takes its roots from a distributed data structure shared on a decentralized network. Although the first attempts of the blockchain technology started in developing cryptocurrencies, this technology has provided opportunities for other fields related to the management of security issues and shared resources. Thus, studies on various aspects of the blockchain technology have formed a growing trend in the related literature. The objective of this chapter is to present the current trends, statistics, and relationships from the growing body of literature on blockchain technology. This research is supported by scientometrics, which is the methodology used to analyze data extracted from online scientific databases to obtain the major trends, research agendas, demographics, particular metrics, networks, and understand leading topics. This research is based on papers published in the Web of Science (WoS) and Scopus databases between 2013 and 2018. The intent of this research is to shed light on the holistic view of blockchain literature and to support the researchers and practitioners in this field.

27.1 Introduction

Business in the modern era continues to adapt to innovation and technological developments. These developments have accelerated the evolution of digital infrastructure and services. Blockchain technology is one of the products of this evolution. This technology is based on the open and distributed database technology (Glaser, 2017; Hawlitschek, Notheisen, & Teubner, 2018). Blockchain technology

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integrates cryptography, peer-to-peer architecture, and smart data discovery (Akoka & Comyn-Wattiau, 2017). A blockchain is a distributed data structure that includes a list of data records confirmed by the participators (Christidis & Devetsikiotis, 2016, p. 2293; Yli-Huumo, Ko, Choi, Park, & Smolander, 2016, p. 1). Mining is done continuously, and thus, the blockchain continuously grows (Tschorsch & Scheuermann, 2016, p. 2087). Blockchain technology has adopted the principle of transparent and accurate declaration. Therefore, the database is open to participants, and all records can be tracked and verified until the first transaction. Owing to its distributed structure, system and network security are independent of any intermediary unit (Apte & Petrovsky, 2016).

The principles and the characteristics of blockchain technology were used to develop a cryptographic currency, otherwise known as cryptocurrency. The first proposal of cryptographic currency as a conceptual model is Chaum's "untraceable payments" in the 1980s (Bonneau et al., 2015, p. 105). However, the technological infrastructure was insufficient to implement this idea until 2008, when Nakamoto developed Bitcoin based on blockchain technology (Miers, Garman, Green, & Rubin, 2013, p. 399; Nakamoto, 2008). Bitcoin cryptocurrency records its transactions in blockchain (Eyal & Sirer, 2018, p. 1). Many new, decentralized cryptocurrencies have been proposed recently, but only few of them have become popular in both Finance and Information Technologies (Kosba, Miller, Shi, Wen, & Papamanthou, 2016, p. 839). Bitcoin was considered to be validation for blockchain technology, and the use of blockchain technology was predicted to expand to other areas. For example, blockchain technology is of great interest for shareholders in various industries, such as finance (Guo & Liang, 2016), healthcare (Azaria, Ekblaw, Vieira, & Lippman, 2016; Mettler, 2016), government (Atzori, 2015; Christidis & Devetsikiotis, 2016, p. 2292; Olnes, 2016), public management (Biswas & Muthukkumarasamy, 2016), and chemistry (Sikorski, Haughton, & Kraft, 2017).

The increasing trend of using blockchain technology has been featured in various review papers. Yuan and Wang (2016) present a review describing the blockchain technology and its potential for future innovation. Furthermore, Zheng, Xie, Dai, Chen, and Wang (2017) investigated the architectures and the common algorithms used to develop a blockchain, and they discussed improvements in technical challenges to highlight the future trends in this field. Lastly, Zeng and Ni (2018) conducted a bibliometric analysis on blockchain research papers that were published between 2011 and 2017 to present the academic social network in the related literature as well as the demographics of authors and institutions.

Many other review studies can be found on the particular implementations and technologies regarding blockchains. The growing number of the papers and the diversity of the studies on this technology have led to a need for review studies to shed light on the future research potential of blockchain technology. This study is motivated by this gap in the literature. This paper intends to analyze recent blockchain literature (2013–2018) using the method of scientometrics (Sengupta, 1992) to provide insights into the field by shedding light on a variety of details on the literature. These details include funding, countries and universities where studies took place, and leading authors frequently receiving references. Additionally, this chapter will present the main topics in blockchain technology as determined by keywords, as well as their interrelation.

This chapter makes use of technology and tools offered by scientometrics to present an extensive review of blockchain technology. The objective of this chapter is to map out the leading work, the major trends in the field, and the changes in the field over time. Papers were included in this study if blockchain was found either in the title or the abstract, or the keywords of the studies published throughout the specified timeframe. Thus, regardless of their category or discipline, all the studies in which blockchain technology appeared in the Web of Science (WoS) or Scopus databases were included into the analysis. Although this study covers a shorter period than other published reviews on blockchain technology, our paper sheds light on changes in the major trends. Furthermore, this chapter has a wide research agenda that covers scientometrics of blockchain technology, including particular metrics, descriptive statistics, and advanced text and network analytics to reveal clusters and relationships.

27.2 Methodology

27.2.1 The Scope of the Research

The scope of the research is to analyze the papers within WoS and Scopus databases written on blockchain research to reveal information on the following:

- Publication statistics
- Author and citation statistics
- Country statistics and relationships
- Institutions
- Research areas
- Keywords and relevant topics

27.2.2 Data Sources and Datasets

The analyzed data were extracted from the WoS and Scopus online databases. The studies analyzed included research articles, proceedings papers, editorial material, review articles, book chapters, book reviews, conference papers, and short surveys, among other documents. Therefore, the analyses cover the bulk of the literature on blockchain technology from the WoS Database (1296) and Scopus database (4491). The search began on January 4th, 2019, and the analysis was completed by January 15th, 2019. This search included all studies that included "blockchain technology" in their title, abstract, or keywords, among articles published in WoS and Scopus databases. Different data structures can be gathered for different document types, hence, some of the document types were not included in this analysis if they lacked information or quality problems in their data. For example, one of these problem is the missing data in the related fields of the database.

27.2.3 Scientometrics

Scientometrics is a methodology that first analyzes bibliometric data to reveal the current performance in related literature over particular metrics and statistics. The method applies advanced text and network analytics to extract clusters and networks for citations, co-citations, co-authorships, and co-occurrence networks by considering various dimensions together such as authors, countries, institutions, and journals (Al, 2008; Chen, Ibekwe-SanJuan, & Hou, 2010; Darko, Chan, Huo, & Owusu-Manu, 2019, p. 503; Garfield, 2009; Sengupta, 1992). Scientometrics shares characteristics with similar methodologies, such as bibliometrics, informetrics or webometrics. Informetrics is the base methodology for scientometrics. Scientometrics or slightly differs from bibliometrics and webometrics because scientometrics has a multidimensional nature of visualization, and it uses particular metrics for comparisons. However, it is still difficult to position this kind of analysis in the literature in only one of bibliometrics, scientometrics, or the other related methodologies (Yang & Yuan, 2017).

In accordance with the methodology of scientometrics, the findings in this research are extracted using following analyses:

- Publication statistics based on different demographics
- Co-authorship analysis
- Bibliographic coupling
- Co-occurrence analyses

The background of these analyses come from descriptive statistics, text, and network analytics. The related findings are presented in summary tables as well as particular networks to indicate the relationships over clusters and time.

27.2.4 Software Tools

This research was performed by searching all fields in Scopus databases and all topics in WoS databases. The retrieved content contained the full records and cited references in plain text as a tab-delimited txt file. The data exported was then stored in a relational database designed in Oracle platform through a special coding developed in the Hypertext Preprocessor Programming (PHP) language, with the goal of obtaining queries with Structured Query Language (SQL) and performing customized analyses. For the analytical stages of the methodology, the following software tools were used: VOSviewer for the studies in WoS database (van Eck &

Waltman, 2009) for network/density visualizations and clustering on the networks and MS-Excel for consolidating the queries and descriptive statistics.

27.3 The Big Picture of the Blockchain Literature Between 2013 and 2018

27.3.1 Overview of the Studies

Results show that the number of published documents about blockchain technology has been constantly increasing over time (Table 27.1). The years 2017 and 2018 stand out as the most productive years of for publications in all languages.

The frequencies of the studies in WoS database (1296) are proceedings paper (*f*: 588, 45.37%), article (*f*: 582, 44.90), editorial material (*f*: 69, 5.32%), review (*f*: 32, 2.47%), news item (*f*: 12, 0.93%), meeting abstract (f: 10, 0.77%), book chapter (*f*: 8, 0.62%), book review (*f*: 6, 0.46%), letter (*f*: 6, 0.46%), and correction (*f*: 4, 0.31%), respectively.

The frequencies of the studies in Scopus database (4491) are conference paper (*f*: 2116, 47.12%), article (*f*: 1420, 31.62%), conference review (*f*: 242, 5.39%), article in press (*f*: 199, 4.43%), book chapter (*f*: 172, 3.83%), review (*f*: 157, 3.50%), book (*f*: 62, 1.38%), editorial (*f*: 51, 1.14%), note (*f*: 41, 0.91%), short survey (*f*: 16, 0.36%), letter (*f*: 10, 0.22%), erratum (*f*: 3,0.06), business article (*f*: 1, 0.02%), and retracted (*f*: 1, 0.02%), respectively. In this chapter, only original articles and review studies were included in certain analyses, such as networks, because the data quality varies for the other document types. In this context, some analyses were conducted over 614 papers from Web of Science and 1577 papers from Scopus. Review papers are not listed separately in Table 27.1, but they are included in the total column.

27.3.2 Authors

1296 studies or documents in the WoS database were produced by 3118 different authors in total. Two hundred authors produced at least three studies. Additionally, 4491 studies in the Scopus database were produced by 9191 different authors in total. Table 27.2 presents the authors who have the highest number of publications. Xu, X.W.; Li, H.; Zhang, Y. and Choo, K.K.R. have the highest number of publications in blockchain research in WoS database, whereas Wang, F.Y. and Yuan, Y. lead in Scopus database.

Results show that 938 authors produced at least three studies. Results of co-authorship analysis, which shows the connections between authors is shown in a network and a heat map (Fig. 27.1).

Table 27.1 Number of documents over years

Year	Document count						%					
	WoS			Scopus			WoS			Scopus		
	Proc.	Article	Total	Proc.	Article	Total	Proc.	Article	Total	Proc.	Article	Total
2018	179	396	649	1350	1007	2948	30.44	68.04	50.01	63.80	70.91	65.64
2017	307	157	501	565	318	1175	52.21	26.97	38.66	26.70	22.39	26.16
2016	78	28	118	133	72	259	13.27	4.81	9.11	6.29	5.07	5.77
2015	15	1	19	42	19	76	2.55	0.17	1.47	1.99	1.34	1.69
2014	7	0	7	22	2	27	1.19	0	0.54	1.04	0.14	0.60
2013	2	0	2	4	2	6	0.34	0	0.15	0.19	0.14	0.13
All	588	582	1296	2116	1420	4491	45.37	44.90	100	47.12	31.62	100

Table 27.2 Contributions to the literature according to number of studies

	Authors		Document count		%	
Rank	WoS	Scopus	WoS	Scopus	WoS	Scopus
1	Xu, X.W.	Wang, F.Y.	10	23	0.79	0.51
2	Li, H.	Yuan, Y.	9	16	0.71	0.36
3	Zhang, Y.	Shi, E.	9	15	0.71	0.33
4	Choo, K.K.R.	Xu, X.	9	15	0.63	0.33
5	Wang, J.	Zheng, D.	8	15	0.63	0.33
6	Du, X.J.	Shi, W.	8	14	0.63	0.31
7	Eyal, I.	Xu, L.	7	14	0.55	0.31
8	Kshetri, N.	Chen, L.	7	14	0.55	0.31
9	Wang, F.Y.	Zhang, Y.	7	14	0.55	0.31
10	Li, J.	Gao, Z.	6	13	0.47	0.29
11	Liu, Y.	Miller, A.	6	13	0.47	0.29
12	Park, J.H.	Park, J.H.	6	13	0.47	0.29
13	Sassone, V.	Weber, I.	6	13	0.47	0.29
14	Shetty, S.	Du, X.	6	12	0.47	0.27
15	Sirer, E.G.	Lu, Y.	6	12	0.47	0.27
16	Tsai, W.T.	Shetty, S.	6	12	0.47	0.27
17	Weber, I.	Deters, R.	6	11	0.47	0.25
18	Yuan, Y.	Kiayias, A.	6	11	0.47	0.25
19	Zheng, D.	Lee Kuo Chuen, D.	6	11	0.47	0.25
20	Zhu, L.H.	Choo, K.K.R.	6	11	0.47	0.25

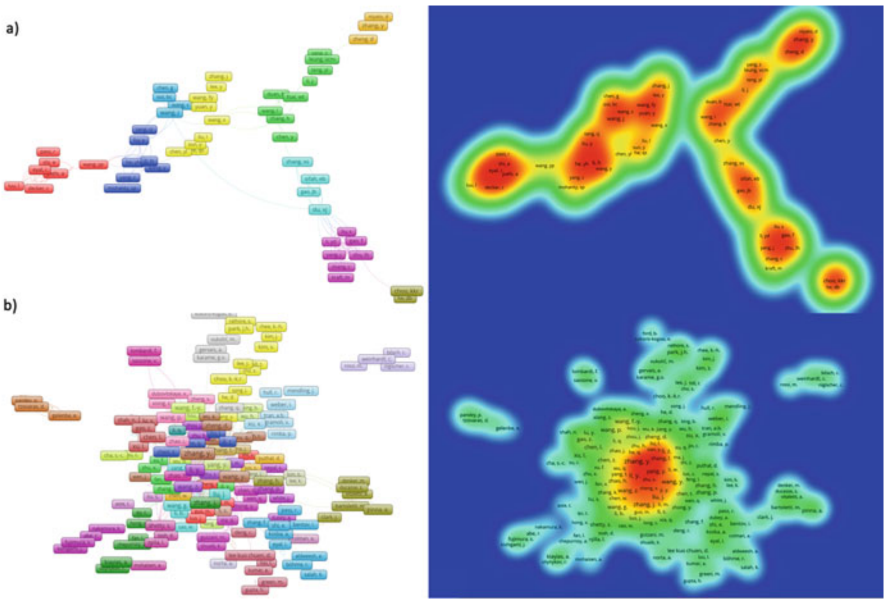

Fig. 27.1 Co-authorship-author cluster/density analyzes (≥3 Studies). (The left side of Fig. 27.1 shows network clusters where the same colors indicate the authors working together. The right side of the Fig. 27.1 exhibits densities that result in a same manner)

In the WoS database, there are clear islands that are comprised of particular authors, whereas there is a certain core and a cellular structure in the Scopus database in which particular author groups can be seen.

27.3.3 Countries

Table 27.3 demonstrates the leading countries with frequencies and percentages in both databases. Results show that the United States leads in blockchain publications. In both databases, more than 20% of publications originated from the United States. China has the second highest number of publications, England has the third highest number of publications, and Germany, Italy, and Australia follow.

Co-authorship analysis regarding countries by the time is presented in Fig. 27.2 as an overlay visualization for both WoS and Scopus databases. Most of the studies were published in the 2018. Earlier papers in WoS were published by authors from Israel, Wales, Scotland, Poland, and Japan where the earlier papers in Scopus are from are Estonia, Romania, and South Africa. Recently, authors from Turkey, Russia, and Croatia in published in WoS. Authors from Slovenia, USA, Ecuador, and Argentina in Scopus contributed to related literature.

Table 27.3 Leading countries

	Countries		Document count		%	
Rank	WoS	Scopus	WoS	Scopus	WoS	Scopus
1	United States	United States	294	950	22.69	21.15
2	China	China	274	823	21.14	18.33
3	England	England	101	418	7.79	9.31
4	Germany	Germany	91	325	7.02	7.23
5	Italy	Italy	75	209	5.79	4.66
6	Australia	Australia	62	194	4.78	4.32
7	South Korea	India	59	171	4.55	3.81
8	France	France	50	161	3.86	3.58
9	Russia	Switzerland	46	157	3.55	3.50
10	Canada	Canada	43	155	3.32	3.45
11	Japan	South Korea	43	152	3.32	3.38
12	India	Russia	40	135	3.09	3.01
13	Switzerland	Singapore	38	116	2.93	2.58
14	Singapore	Spain	34	105	2.62	2.34
15	Spain	Japan	30	99	2.32	2.20
16	Netherlands	Netherlands	23	95	1.78	2.12
17	Norway	Austria	21	80	1.62	1.78
18	Taiwan	Greece	21	62	1.47	1.38
19	Austria	Denmark	19	61	1.24	1.35
20	Brazil	HongKong	16	58	1.24	1.29

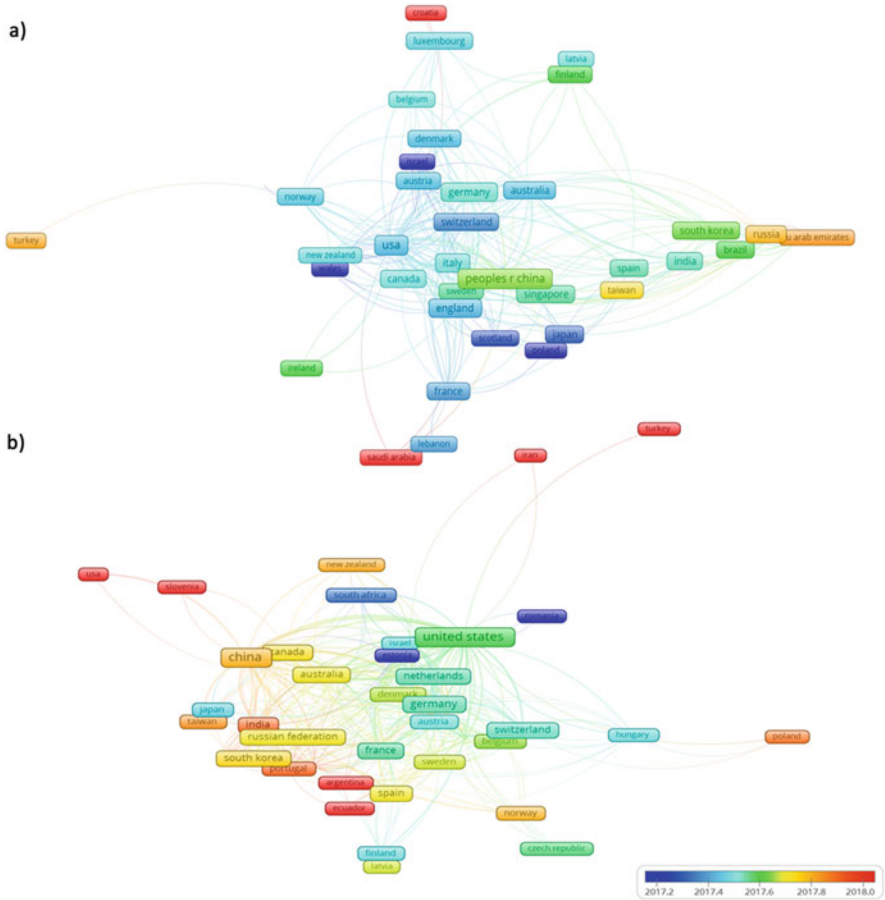

Fig. 27.2 Co-authorship-country overlay visualization analyzes

27.3.4 The Related Research Areas

This section reports the top 20 research areas related to blockchain technology. Computer Science and Engineering research areas are at the top in both databases (Table 27.4). According to WoS database, Telecommunications comes in third place with 19.60% coverage, followed by Business Economics and Government Law research areas. In Scopus database, Mathematics comes in third place with 20.75%, followed by Business, Management and Accounting and Social Sciences research areas. The primary research areas in both databases are similar to each other. Interestingly, Areas in social sciences, such as Philosophy and Psychology have also conducted research on blockchain technology. Additionally, Environmental and Health sciences are the other professions that are interested in this field.

Table 27.4 Top 20 research areas related with blockchain

Rank	Research areas		Document count		%	
	WoS	Scopus	WoS	Scopus	WoS	Scopus
1	Computer Science	Computer Science	705	3161	54.40	70.39
2	Engineering	Engineering	413	1365	31.87	30.39
3	Telecommunications	Mathematics	254	932	19.60	20.75
4	Business Economics	Business, Management and Accounting	136	574	10.50	12.78
5	Government Law	Social Sciences	56	513	4.32	11.42
6	Science Technology Other Topics	Decision Sciences	56	422	4.32	9.40
7	Energy Fuels	Economics, Econometrics and Finance	32	341	2.47	7.59
8	Automation Control Systems	Energy	29	238	2.24	5.30
9	Information Science Library Science	Materials Science	28	183	2.16	4.07
10	Chemistry	Physics and Astronomy	20	145	1.54	3.23
11	Environmental Sciences Ecology	Medicine	20	135	1.54	3.01
12	Health Care Sciences Services	Environmental Science	18	133	1.39	2.96
13	Medical Informatics	Biochemistry, Genetics and Molecular Biology	18	117	1.39	2.61
14	Operations Research Management Science	Chemistry	15	81	1.16	1.80
15	Physics	Arts and Humanities	15	62	1.16	1.38
16	Philosophy	Chemical Engineering	14	47	1.08	1.05
17	Education Educational Research	Agricultural and Biological Sciences	13	43	1.00	0.96
18	Electrochemistry	Psychology	12	35	0.93	0.78
19	Instruments Instrumentation	Earth and Planetary Sciences	12	30	0.93	0.67
20	Public Administration	Pharmacology, Toxicology and Pharmaceutics	11	25	0.85	0.56

27.3.5 Sources and Papers

Leading Journals were determined by the number of studies published in WoS Database and Scopus Database (Tables 27.5 and 27.7). Leading works are also listed in Table 27.6.

The citation statistics for WoS database are presented in Table 27.5. This table shows 5-year impact factors, average citations per item, demographics, and *h*-index values of the journals. Scopus database tracks citation statistics over different

Table 27.5 Leading journals according to number of studies published (WoS Database)

Rank	Journal	Publisher country	5YIF*	Research domain	H***	ACPI**	N	% 1296
1	IEEE Access	USA	4.199	Computer Science; Engineering; Telecommunications	8	5.64	56	4.32
2	Sensors	Switzerland	3.014	Chemistry; Electrochemistry; Instruments & Instrumentation	1	1.08	12	0.93
3	Journal of Medical Systems	USA	2.398	Health Care Sciences & Services; Medical Informatics	2	4	11	0.85
4	Sustainability	Switzerland	2.177	Science & Technology—Other Topics; Environmental Sciences & Ecology	2	1.09	11	0.85
5	Computer Law Security Review	England	1.112	Government & Law	1	0.67	9	0.69
6	IEEE Cloud Computing	USA	–	Computer Science	3	2.44	9	0.69
7	IEEE Spectrum	USA	1.421	Engineering	3	2.67	9	0.69
8	IT Information Technology	Germany	–	Computer Science, Information Systems	1	0.11	9	0.69
9	Future Generation Computer Systems The International Journal of ESCIENCE	Netherlands	4.969	Computer Science	3	3.88	8	0.62
10	IEEE Communications Magazine	USA	10.954	Engineering; Telecommunications	4	4.38	8	0.62
11	Metaphilosophy	USA	–	Philosophy	1	0.63	8	0.62
12	Security And Communication Networks	England	1.012	Computer Science; Telecommunications	1	1.38	8	0.62
13	Business Information Systems Engineering	Germany	3.586	Computer Science	3	3.29	7	0.54
14	Computer	USA	2.113	Computer Science	3	3.00	6	0.46
15	IT Professional	USA	1.561	Computer Science; Telecommunications	3	4.33	6	0.46

*Five year impact factor, FYIF; **Average citations per item, ACPI; ***h-index: H

Table 27.6 Leading studies (WoS Database)

Rank	Work	Sources	Year	Authors	# (A)	C
1	Blockchains and smart contracts for the Internet of Things	IEEE Access	2016	Christidis, K; Devetsikiotis, M	2	152
2	Decentralizing privacy: Using blockchain to protect personal data	2015 IEEE Security and Privacy Workshops (SPW)	2015	Zyskind, G; Nathan, O; Pentland, A	3	107
3	Hawk: The blockchain model of cryptography and privacy-preserving smart contracts	2016 IEEE Symposium on Security and Privacy (SP)	2016	Kosba, A; Miller, A; Shi, E; Wen, Z; Papamanthou, C	5	81
4	Bitcoin and beyond: A technical survey on decentralized digital currencies	IEEE Communications Surveys and Tutorials	2016	Tschorsch, F; Scheuermann, B	2	61
5	Majority is not enough: Bitcoin mining is vulnerable	Financial Cryptography and Data Security, Fc 2014	2014	Eyal, I; Sirer, EG	2	58
6	Where is current research on blockchain technology?-A systematic review	Plos One	2016	Yli-Huumo, J; Ko, D; Choi, S; Park, S; Smolander, K	5	42
7	MedRec: Using blockchain for medical data access and permission management	Proceedings 2016 2nd International Conference on Open and Big Data—OBD 2016	2016	Azaria, A; Ekblaw, A; Vieira, T; Lippman, A	4	40
8	Bitcoin-NG: A scalable blockchain protocol	13th USENIX Symposium on Networked Systems Design and Implementation (NSDI)	2016	Eyal, I; Gencer, AE; Sirer, EG; van Renesse, R	4	39
9	An ID-based linearly homomorphic signature scheme and its application in blockchain	IEEE Access	2018	Lin, Q; Yan, HY; Huang, ZG; Chen, WB; Shen, J; Tang, Y	6	37
10	Healthcare data gateways: Found healthcare intelligence on blockchain with novel privacy risk control	Journal of Medical Systems	2016	Yue, X; Wang, HJ; Jin, DW; Li, MQ; Jiang, W	5	37
11	Designing microgrid energy markets A case study: The Brooklyn microgrid	Applied Energy	2018	Mengelkamp, E; Garttner, J; Rock, K; Kessler, S; Orsini, L; Weinhardt, C	6	34

(continued)

Table 27.6 (continued)

Rank	Work	Sources	Year	Authors	# (A)	C
12	Blockchain technology in the chemical industry: Machine-to-machine electricity market	Applied Energy	2017	Sikorski, JJ; Haughton, J; Kraft, M	3	33
13	Blockchain beyond bitcoin	Communications of The ACM	2016	Underwood, S	1	33
14	BitIodine: Extracting intelligence from the bitcoin network	Lecture Notes in Computer Science	2014	Spagnuolo, M; Maggi, F; Zanero, S	3	28
15	The truth about blockchain	Harvard Business Review	2017	Lansiti, M; Lakhani, K.R.		24
16	Blockstack: A global naming and storage system secured by blockchains	USENIX Annual Technical Conference (ATC)	2016	Ali, M; Nelson, J; Shea, R; Freedman, MJ	4	24
17	Making smart contracts smarter	23rd ACM Conference on Computer and Communications Security (CCS)	2016	Luu, L; Chu, DH; Olickel, H; Saxena, P; Hobor, A	5	24
18	An overview of blockchain technology: architecture, consensus, and future trends	IEEE sixth International Congress on Big Data (BigData Congress)	2017	Zheng, ZB; Xie, SA; Dai, HN; Chen, XP; Wang, HM	5	23
19	Enabling localized peer-to-peer electricity trading among plug-in hybrid electric vehicles using consortium blockchains	IEEE Transactions on Industrial Informatics	2017	Kang, JW; Yu, R; Huang, XM; Maharjan, S; Zhang, Y; Hossain, E	6	21
20	Managing IoT devices using blockchain platform	19th International Conference on Advanced Communication Technology (ICACT)	2017	Huh, S; Cho, S; Kim, S	3	21

FYIF Five year impact factor, *C* Citations

metrics. Table 27.7 shows journal name, publisher, subject area, and SCImago Journal Rank (SJR) and CiteScore for 2017. According to the SJR metric, where a reference comes from is important because each journal has specific prestige specific in its own area. If it is cited by a journal of high prestige (a journal with a high SJR value), this indicates that the journal has a high citation value. The opposite situation indicates that the journal's citation value is low (Zan, 2012). When both tables are compared, it can be seen that there are similarities between the journals featured in both databases. Additionally, the journals that focus on computer science, medical systems, sustainability, and finance have the highest prestige by taking the first places.

Table 27.7 Leading journals according to number of studies published (Scopus Database)

Rank	Journal	Publisher	Subject Area	SJR	CS	N
1	IEEE Access	IEEE	Engineering: General Engineering; Computer Science: General Computer Science; Materials Science: General Materials Science	0.548	4.49	100
2	Sensors Switzerland	Multidisciplinary Digital Publishing Institute	Physics and Astronomy: Instrumentation; Physics and Astronomy: Atomic and Molecular Physics, and Optics; Engineering: Electrical and Electronic Engineering; Chemistry: Analytical Chemistry; Biochemistry, Genetics and Molecular Biology: Biochemistry	0.584	3.23	39
3	Sustainability Switzerland	Multidisciplinary Digital Publishing Institute	Social Sciences: Geography, Planning and Development; Environmental Science: Management, Monitoring, Policy and Law; Energy: Renewable Energy, Sustainability and the Environment	0.537	2.37	32
4	IEEE Internet of Things Journal	IEEE	Computer Science: Signal Processing; Computer Science: Information Systems; Computer Science: Hardware and Architecture; Computer Science: Computer Science Applications; Computer Science: Computer Networks and Communications	1.341	10.53	24
5	International Journal of Engineering and Technology UAE	Science Publishing Corporation Inc	Chemical Engineering: General Chemical Engineering; Engineering: General Engineering; Computer Science: Computer Science (miscellaneous) Biochemistry, Genetics and Molecular Biology: Biotechnology; Environmental Science:	0.102	0.08	22

(continued)

Table 27.7 (continued)

Rank	Journal	Publisher	Subject Area	SJR	CS	N
			Environmental Engineering; Computer Science: Hardware and Architecture			
6	Security and Communication Networks	Wiley-Blackwell	Computer Science: Computer Networks and Communications; Computer Science: Information Systems	0.285	1.36	21
7	Future Generation Computer Systems	Elsevier	Computer Science: Software; Computer Science: Hardware and Architecture; Computer Science: Computer Networks and Communications	0.844	4.76	20
8	Zhongguo Dianji Gongcheng Xuebao Proceedings of the CSEE	Zhongguo Dianji Gongcheng Xuehui	Engineering: Electrical and Electronic Engineering	0.909	2.42	18
9	Journal of Supercomputing	Springer Nature	Mathematics: Theoretical Computer Science; Computer Science: Hardware and Architecture; Computer Science: Information Systems; Computer Science: Software	0.407	1.98	17
10	Energies	Multidisciplinary Digital Publishing Institute	Mathematics: Control and Optimization; Energy: Energy Engineering and Power Technology; Engineering: Electrical and Electronic Engineering; Energy: Energy (miscellaneous); Energy: Renewable Energy, Sustainability and the Environment	0.670	3.15	16
11	Zidonghua Xuebao Acta Automatica Sinica	Science Press	Engineering: Control and Systems Engineering; Computer Science: Computer Graphics and Computer-Aided Design; Computer Science: Information	0.355	1.52	15

(continued)

Table 27.7 (continued)

Rank	Journal	Publisher	Subject Area	SJR	CS	N
			Systems; Computer Science: Software			
12	IT Professional	IEEE	Computer Science: Computer Science Applications; Computer Science: Hardware and Architecture; Computer Science: Software	0.280	1.03	14
13	IEEE Security and Privacy	IEEE	Social Sciences: Law; Engineering: Electrical and Electronic Engineering; Computer Science: Computer Networks and Communications	0.360	1.47	13
14	Journal of Network and Computer Applications	Elsevier	Computer Science: Hardware and Architecture; Computer Science: Computer Science Applications; Computer Science: Computer Networks and Communications	0.784	5.13	13
15	Computer Law and Security Review	Elsevier	Social Sciences: Law; Business, Management and Accounting: General Business, Management and Accounting; Computer Science: Computer Networks and Communications	0.334	0.78	12

SJR SCImago Journal Rank (2017), *CS* CiteScore 2017

For 1296 documents, the total number of citations used totals to 14,787 in WoS database. When these cited sources are analyzed, results show that there are 160 documents that were cited 20 times or more. Top ten leading sources for the number of citations in WoS database are Lecture Notes in Computer Science (*f*: 897), Bitcoin Peer to Peer (*f*: 525), IEEE Access (*f*: 287), Technical Reports (*f*: 267), IEEE Security and Privacy Magazine (*f*: 262), Communications of the ACM (*f*: 193), Blockchain Blueprint (*f*: 150), IEEE Communications Surveys & Tutorials (*f*: 121), Thesis (*f*: 118), Applied Energy (*f*: 117), respectively.

Among documents retrieved from Scopus, 4491 documents cited 75,753 different sources. There are 592 sources, 1960 authors, and 17 papers having 20 or more citations. Top ten leading sources for the number of citations in Scopus are Lecture Notes in Computer Science (*f*: 1946), IEEE access (*f*: 711), Proceedings of the ACM Conference on Computer and Communications Security (*f*: 622), Future Generation Computer Systems (*f*: 172), ACM international Conference Proceeding

Series (*f*: 120), Sensors (Switzerland) (*f*: 117), Security and Communication Networks (*f*: 94), Procedia Computer Science (*f*: 83), IEEE Internet of Things Journal (*f*: 82), and Sustainability (Switzerland), respectively. Most of the retrieved sources are journals, but books and theses were also included.

Nakamoto's contribution to the literature is clear (Nakamoto, 2008). Satoshi Nakamoto is the founder of the digital currency Bitcoin, which has been widely mentioned in recent years. The true creator behind Bitcoin is not known. The only thing that is known is that his founder used the nickname Satoshi Nakamoto. There is little information available about Nakamoto except from a nine-page pdf file titled, "Bitcoin: A Peer-to-Peer Electronic Cash System." It is common to cite to this work in Bitcoin-related documents. Swan (2015), who has 136 citations, has the second highest number of citations. Christidis and Devetsikiotis (2016) who have 123 citations, have the third highest number of citations, followed by Zyskind, Nathan, and Pentland (2015).

In WoS, 1296 documents cited 24,422 references. Fifty one of these references were cited more than 20 times in the dataset. When the first authors of the papers are analyzed, 16,207 authors are found in the reference list of 1296 documents. Furthermore, 127 of the authors were cited more than 20 times in the same dataset. The top 15 authors and their citation counts are Nakamoto, S. (*f*: 580); Swan, M. (*f*: 202); Buterin, V. (*f*: 159); Eyal, I. (*f*: 139); Wood, G. (*f*: 135); Zyskind, G. (*f*: 129); Christidis, K. (*f*: 127); Lamport, L. (*f*: 117); Bonneau, J. (*f*: 95); Szabo, N. (*f*: 94); Castro, M. (*f*: 90); Tapscott, D. (*f*: 83); Luu, L. (*f*: 82); Decker, C. (*f*: 79); Kosba, A. (*f*: 76); respectively.

In Scopus, 4491 documents cite144,441 different documents and 120,128 different authors. The top-cited 15 authors for the 4491 documents and their corresponding citation counts are Nakamoto, S. (*f*: 1679); Li, J. (*f*: 941); Miller, A. (*f*: 937); Zhang, Y. (*f*: 808); Shi, E. (*f*: 723); Buterin, V. (*f*: 614); Chen, X. (*f*: 525); Eyal, I. (*f*: 512); Swan, M. (*f*: 493); Wang, Y. (*f*: 454); Wang, X. (*f*: 451); Wood, G. (*f*: 448); Bonneau, J. (*f*: 442); Narayan, A. (*f*: 438); Wang, H. (*f*: 419); respectively. When the data obtained from both databases are analyzed, Nakamoto's contribution to the literature again is clear. The top-cited authors of the data obtained from both databases are similar.

The sources publishing relatively a high number of papers in blockchain research (Tables 27.5 and 27.7) are classified under particular research domains, such as Computer Science, Computer Networks and Communications, Engineering, and Telecommunications. Additionally, research domains such as Social Sciences, Environmental Science, Policy, and Law have contributed to blockchain literature.

The leading papers, based on the number of times they were cited, are presented in Tables 27.6 and 27.8. Results show that the first three studies that have the most citations are similar. Among these studies, "Blockchains and Smart Contracts for the Internet of Things" leads with 152 citations, according to WoS Database and with 277 citations, according to Scopus Database, followed by "Decentralizing Privacy: Using Blockchain to Protect Personal Data" and "Hawk: The Blockchain Model of Cryptography and Privacy-Preserving Smart Contracts" in both databases. Tables 27.6 and 27.8 show that in general, the most-cited studies were written by

Table 27.8 Leading studies (Scopus Database)

Rank	Title of the Study	Sources	Year	Authors	# (A)	C
1	Blockchains and smart contracts for the Internet of Things	IEEE Access 4,7467408, pp. 2292–2303	2016	Christidis, K.; Devetsikiotis, M.	2	277
2	Decentralizing privacy: Using blockchain to protect personal data	Proceedings—2015 IEEE Security and Privacy Workshops, SPW 2015, 7163223, pp. 180–184	2015	Zyskind, G.; Nathan, O.; Pentland, A.S.	3	227
3	Hawk: The blockchain model of cryptography and privacy-preserving smart contracts	Proceedings—2016 IEEE Symposium on Security and Privacy, SP 2016, 7546538, pp. 839–858	2016	Kosba, A.; Miller, A.; Shi, E.; Wen, Z.; Papamanthou, C.	5	186
4	Zerocoin: Anonymous distributed e-cash from Bitcoin	Proceedings—IEEE Symposium on Security and Privacy 6547123, pp. 397–411	2013	Miers, I.; Garman, C.; Green, M.; Rubin, A.D.	4	172
5	SoK: Research perspectives and challenges for bitcoin and cryptocurrencies	Proceedings—IEEE Symposium on Security and Privacy 2015-July,7163021, pp. 104–121	2015	Bonneau, J.; Miller, A.; Clark, J.; Narayanan, A.; Kroll, J.A.; Felten, E.W.	6	169
6	Quantitative analysis of the full Bitcoin transaction graph	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) 7859 LNCS, pp. 6–24	2013	Ron, D.; Shamir, A.	2	161
7	Bitcoin: Economics, technology, and governance	Journal of Economic Perspectives 29(2), pp. 213–238	2015	Böhme, R.; Christin, N.; Edelman, B.; Moore, T.	4	138
8	Information propagation in the Bitcoin network	13th IEEE International Conference on Peer-to-Peer Computing, IEEE P2P 2013—Proceedings 6688704	2013	Decker, C.; Wattenhofer, R.	2	136
9	Majority is not enough: Bitcoin mining is vulnerable	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) 8437, pp. 436–454	2014	Eyal, I.; Sirer, E. G.	2	130

(continued)

Table 27.8 (continued)

Rank	Title of the Study	Sources	Year	Authors	# (A)	C
10	Bitcoin and beyond: A technical survey on decentralized digital currencies	IEEE Communications Surveys and Tutorials, 18(3), 7423672, pp. 2084–2123	2016	Tschorsch, F.; Scheuermann, B.	2	112
11	Making smart contracts smarter	Proceedings of the ACM Conference on Computer and Communications Security, 24–28-October-2016, pp. 254–269	2016	Luu, L.; Chu, D.-H.; Olickel, H.; Saxena, P.; Hobor, A.	5	111
12	Blockchain: The state of the art and future trends	Zidonghua Xuebao/ Acta Automatica Sinica, 42(4), pp. 481–494	2016	Yuan, Y.; Wang, F.-Y.	2	108
13	On the security and performance of Proof of Work blockchains	Proceedings of the ACM Conference on Computer and Communications Security, 24–28-October-2016, pp. 3–16	2016	Gervais, A.; Karame, G.O.; Wüst, K.; Glykantzis, V.; Ritzdorf, H.; Čapkun, S.	6	102
14	Where is current research on blockchain technology?-A systematic review	PloS one, 11(10), pp. e0163477	2016	Yli-Huumo, J.; Ko, D.; Choi, S.; Park, S.; Smolander, K.	5	102
15	MedRec: Using blockchain for medical data access and permission management	Proceedings—2016 2nd International Conference on Open and Big Data, OBD 2016, 7573685, pp. 25–30	2016	Azaria, A.; Ekblaw, A.; Vieira, T.; Lippman, A.	4	98
16	The quest for scalable blockchain fabric: Proof-of-work vs. BFT replication	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) 9591, pp. 112–125	2016	Vukolić, M.	1	80
17	Cutting the gordian knot: A look under the hood of ransom ware attacks	Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) 9148, pp. 3–24	2015	Kharraz, A.; Robertson, W.; Balzarotti, D.; Bilge, L.; Kirda, E.	5	76

(continued)

Table 27.8 (continued)

Rank	Title of the Study	Sources	Year	Authors	# (A)	C
18	Blockchain for IoT security and privacy: The case study of a smart home	2017 IEEE International Conference on Pervasive Computing and Communications Workshops, PerCom Workshops 2017 7917634, pp. 618–623	2017	Dorri, A.; Kanhere, S.S.; Jurdak, R.; Gauravaram, P.	4	73
19	The truth about blockchain	Harvard Business Review 2017 (January-February)	2017	Iansiti, M.; Lakhani, K.R.	2	73
20	Healthcare data gateways: Found healthcare intelligence on blockchain with novel privacy risk control	Journal of Medical Systems, 40(10),218	2016	Yue, X.; Wang, H.; Jin, D.; Li, M.; Jiang, W.	5	69

FYIF Five year impact factor, *C* Citations

a maximum of six authors. It is also evident that the number of single authors is small in both tables. Most studies are generally formed by two-four authors. The proceedings in this in this field have an important place in the literature. The field should be considered as a very up-to-date issue in the literature attracting many areas. Table 27.1, which indicates the increase in the number of studies in recent years, also supports this finding.

Bibliographic coupling, which presents the use of similar references by the journals, were revealed by time through the related network (Fig. 27.3). For these networks, only the articles were considered in the related field and furthermore, the journals, which published at least three articles, were considered to obtain a clear network to observe the relationships. Consequently, bibliographic coupling relationships for 53 journals in WoS and 168 journals in Scopus were presented in the networks.

27.3.6 Institutions and Organizations

Table 27.9 demonstrates the languages of included studies. More than 95% of papers were written in English. Approximately 2–3% of the studies were written in languages other than English. Evidently, most of the international literature on blockchain technology are written in English.

Rankings of the first ten higher education and research institutions according to their contributions in field of blockchain technology are presented in Table 27.10. The table lists universities, research institutions, academies of sciences and other institutions that exceed the scope of higher education institutions, hence this

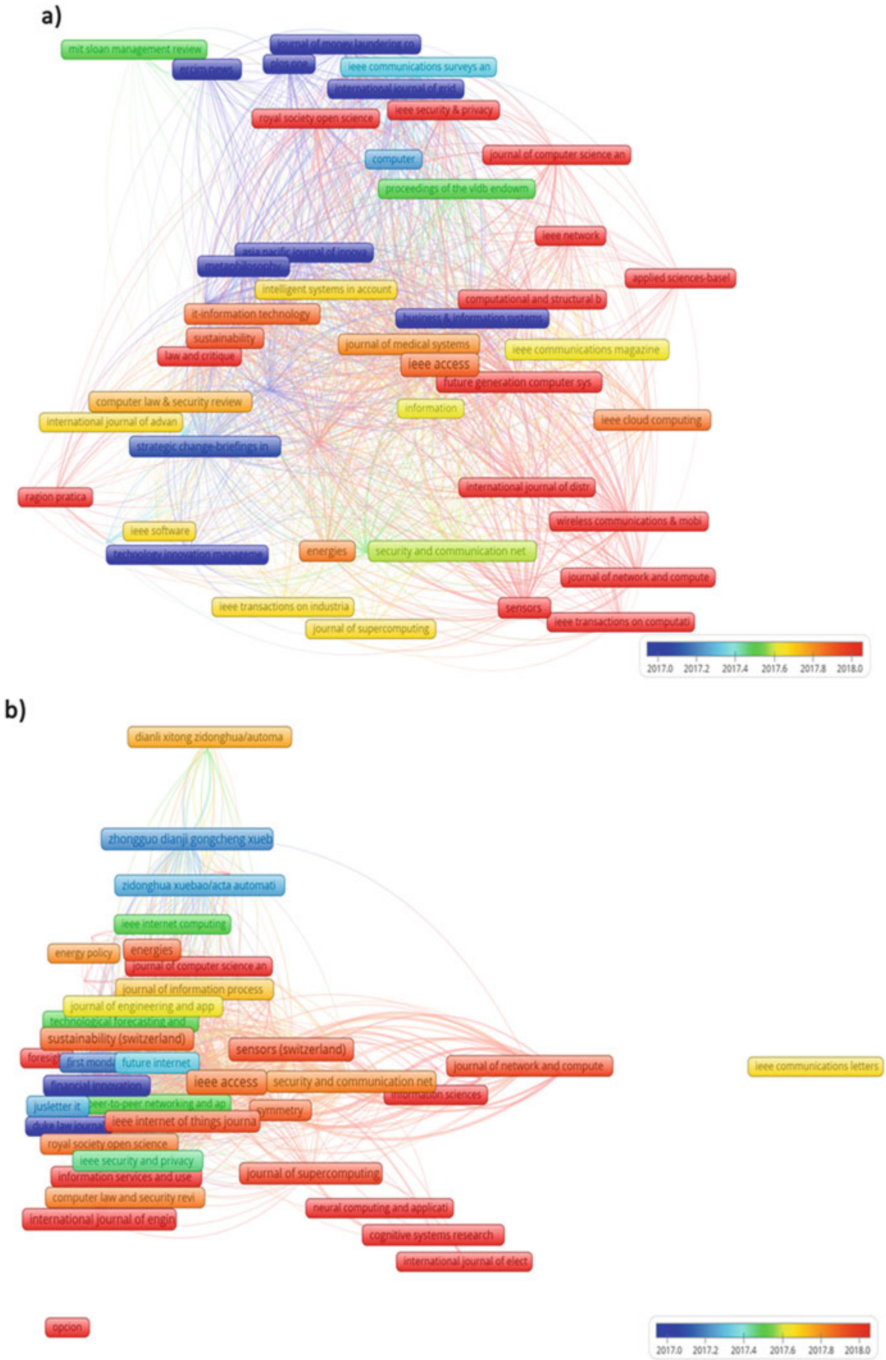

Fig. 27.3 Bibliographic coupling—Sources overlay analysis (for articles)

Table 27.9 Languages of the blockchain literature

Rank	Organizations		Document count		%	
	WoS	Scopus	WoS	Scopus	WoS	Scopus
1	English	English	1264	4320	97.53	96.19
2	Russian	Chinese	9	94	0.69	2.09
3	Spanish	German	7	32	0.54	0.71
4	German	French	5	17	0.39	0.38
5	Italian	Russian	4	14	0.31	0.31

Table 27.10 Contributions to blockchain: Universities and Research Institutions

Rank	Organizations		Document count		%	
	WoS	Scopus	WoS	Scopus	WoS	Scopus
1	Chinese Academy of Sciences	Chinese Academy of Sciences	27	76	2.08	1.70
2	Beijing University of Posts Telecommunications	University of London	21	52	1.62	1.16
3	International Business Machines IBM	Beijing University of Posts and Telecommunications	17	52	1.31	1.16
4	University of London	ETH Zurich	17	44	1.31	0.98
5	University of New South Wales	University of New South Wales	17	39	1.31	0.87
6	Commonwealth Scientific Industrial Research Organization	National University of Defense Technology	16	38	1.24	0.85
7	Cornell University	Centre National de la Recherche Scientifique	16	35	1.24	0.78
8	University of California System	Peking University	16	34	1.24	0.76
9	Universite Paris Saclay Comue	Tsinghua University	14	34	1.08	0.76
10	University of Texas System	University of Chinese Academy of Sciences	14	34	1.08	0.76

category is referred to as "organizations-enhanced." Chinese Academy of Sciences can be found in this list. Chinese institutions take the lead in this list as well. Chinese institutions that rank among the first ten institutions in blockchain technology include Chinese Academy of Sciences, Beijing University of Posts Telecommunications, Beijing University, National University of Defense Technology China, and Peking University. Another country that is evident from the list is the United States. International Business Machines (IBM), Cornell University, University of California System, University of Texas System, Harvard University, and Massachusetts Institute of Technology (MIT) are the leading United States institutions in blockchain technology studies. The 1296 studies in WoS database were produced by 1369 different organizations, whereas 4491 studies in Scopus database were produced by 7633 different organizations. Two hundred and eight organizations in WoS and

Fig. 27.4 Bibliographic coupling—organization overlay visualization (for all documents)

274 organizations in Scopus produced more than three studies on blockchain technology. Bibliographic coupling relationships among these organizations were arranged by time (Fig. 27.4). Pattern of the network is directly related to the network of corresponding countries presented in Fig. 27.2.

Research articles have a significant impact on the literature and present the structured research attempts, from this point of view, organizational networks were exhibited over the research articles which were filtered from the raw data set. Heat maps of the institutions (81 institutions in WoS and 55 institutions in Scopus) based on the article densities are also given in Fig. 27.5 regarding bibliographic coupling.

27.4 Keywords and Potential Topics

Blockchain research domains range widely, leading to a wide range of topics and keywords. In the raw dataset, 2876 keywords were extracted from 1296 documents in WoS and 17,981 keywords were extracted from 4491 documents in Scopus databases.

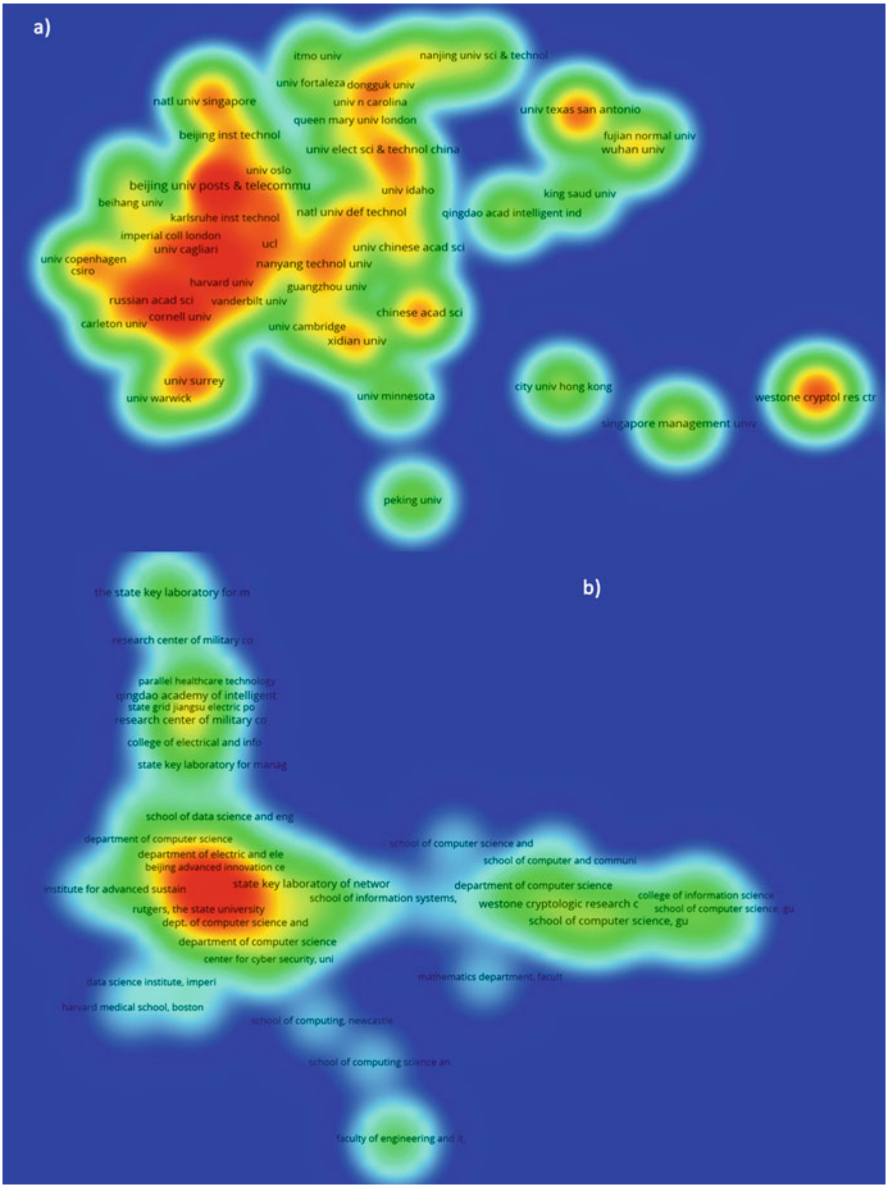

Fig. 27.5 Bibliographic coupling—organization overlay visualization analysis (for Articles)

The types of the documents may be critical for the analyses in the scope of scientometrics, in which detailed information is required for advanced analyses, such as creating networks. Generally speaking, research articles own complete data in the online databases where the other document types may have missing data in some of

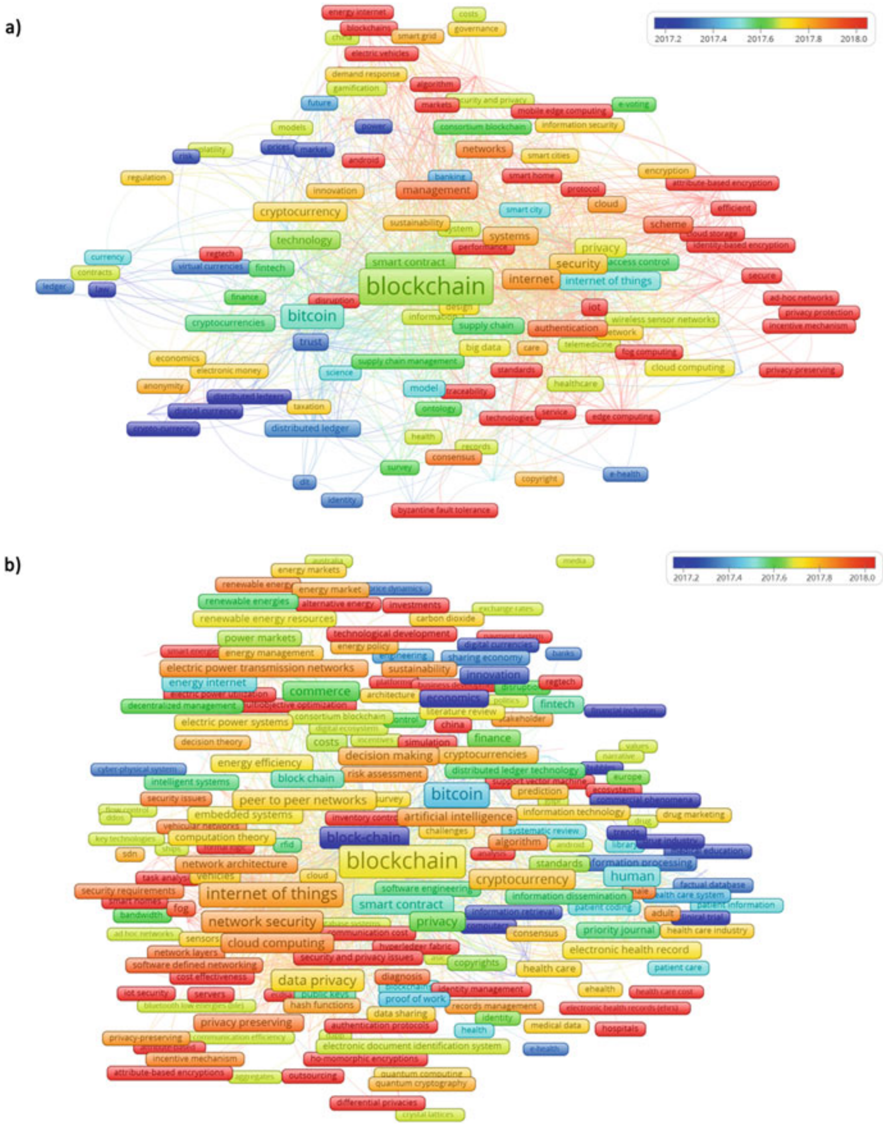

Fig. 27.6 Co-occurrences overlay analysis for all keywords for articles

the fields of the databases. For these articles, it is possible to provide more accurate information in the analysis of keywords, abstracts, and titles. Thus, the results can provide clear findings on the content pattern of the studies. Considering this issue, only research articles from our dataset were included for document type to reveal the main contents of the blockchain literature. 1877 keywords in 614 WoS articles and 8449 keywords in 1577 Scopus articles were extracted to construct the keywords changing by the years (Fig. 27.6) and keyword clusters (Fig. 27.7). Results indicate

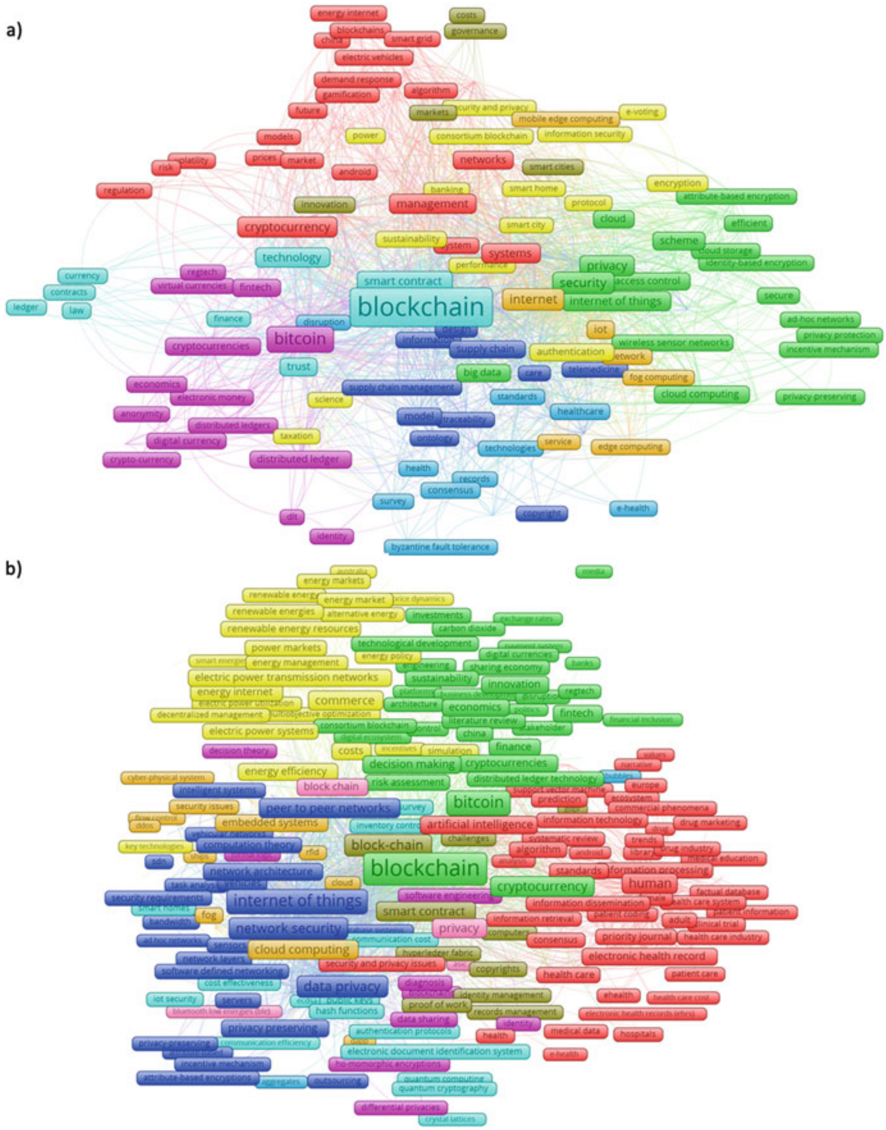

Fig. 27.7 Co-occurrence network analysis for all keywords for articles

the main topics with the help of the keyword co-occurrence analysis. Another filter for the keyword repetitions was used to obtain a clear keyword network such that only the keywords were reflected to the co-occurrence analysis, which were repeated at least three times (160 keywords in WoS and 1035 keywords in Scopus databases).

Although the studies on blockchain technology have been published from 2013 to 2018, the intensity of publication increases in 2017 and 2018 (Table 27.1). This pattern is also observed in the words over years as the distribution in legend varies between 2017 and 2018. When the changes in words are examined by Scopus and WoS databases, it is seen that risk, prices, security, market, law, digital currency, crypto currency, sharing economy, financial inclusion concepts are at the forefront in the first years (Liang, Li, & Zeng, 2018; Mangano, 2018; Millard, 2018; Milnes, 2018; Portnoy, 2018). This pattern is an indication of the fundamental and effective proposal of change that the concept brought to existing financial and legal systems. The structural debates on the markets for digital currency are the hot topics being discussed by governments.

The concepts of patient information, patient coding, health care, health-care system, patient information, e-health were highlighted in both the WOS and Scopus databases. There is important discussion in the literature of touring and keeping the patient data of this condition (Funk, Riddell, Ankel, & Cabrera, 2018; Hölbl, Kompara, Kamišalić, & Nemec Zlatolas, 2018; Wu & Tsai, 2018; Zhang, Deng, Han, & Zheng, 2018). Authors suggest that blockchain technology can be considered as a solution to these issues. Radanović and Likić (2018) provided an overview of the technologies of blockchain technology in the field of health with the study titled "Opportunities for Use of Blockchain Technology in Medicine.

The technological infrastructure of blockchain technology continues, as highlighted by the prevalence of keywords such as systems, performance, cloud storage, attribute-based encryption, efficient, computing, edge computing, security, network security, and standards (Fig. 27.7). Internet of things, one of the most important technological approaches in our time and is widely used in the literature of blockchain technology (Jo, Khan, & Lee, 2018; Qiao, Zhu, Wang, & Qin, 2018; Yu et al., 2018; Yu, Li, Tian, & Liu, 2018). This statement is supported by the close relationship between the two technologies and the fact that blockchain technology provides the appropriate technological infrastructure for the communication of objects. Blockchain technology is an important technology because of the trust that it instills in communication, storage technology, logging and recording of movements on devices, and creating a secure financial system for the load arising from the interrelation of objects.

Another important concept or topic extracted from Fig. 27.7 is energy. The concept is related to the potential to use blockchain technology to develop renewable, sustainable and environmentally friendly energy systems (Di Silvestre, Gallo, Ippolito, Sanseverino, & Zizzo, 2018; Dong, Luo, & Liang, 2018; Noor, Yang, Guo, van Dam, & Wang, 2018; Wu & Tran, 2018; Zhang, Pota, Chu, & Gadh, 2018), as the concept has connections with energy consumption, energy demand, power markets, energy markets, sustainable energy systems, renewable energy, renewable energy resources, smart energies, and energy management.

27.5 Conclusion

Due to its technological infrastructure and its other characteristics like reliability, auditability, interoperability, and being decentralized, the number of published studies on various aspects of the blockchain concept constantly increases. In this chapter, the status of the current literature of blockchain technology in the last 5 years was assessed with the help of scientometrics.

In our research, two large bibliometric datasets containing the studies in the WoS and Scopus databases were processed in VOSViewer application software. Authors, sources, citations, countries, and keywords were analyzed systematically and comparatively to reveal the patterns in the related literature. The findings were presented with summary statistics and tables containing specific metrics, as well as with visualizations obtained by means of text and network analytics were discussed in detail. Thus, this research sheds light on the big picture of the existing literature, which has been developing in recent years.

The author and the citation statistics showed the path followed by the publications over the years and the relationships these entities, thus researchers working on blockchain can discover which authors are important and should be followed in the field. Country and institution statistics and their related connections contribute to the growing body of literature on blockchain technology by presenting leading institutions in this field that have the potential to advance research or careers in blockchain technology. The countries and the related connections can be considered to choose an appropriate location for blockchain research for Masters, PhD, or Post-Doctoral programs. In addition, the source statistics and visualizations revealed the research areas and journals to focus on. Furthermore, keyword analyses, which were conducted in order to reveal the conceptual structure and the subjects studied, show the existing topic patterns and the potential for emerging areas to be discovered.

In conclusion, the chapter provided a holistic view for the existing literature on blockchain research over the well-known online scientific databases which can be considered as the representative data for the related literature. The analyses and the evaluations were performed over various dimensions such as authors, references, keywords, and years. The result of the analyses in the scope of text clustering were visualized with the help of networks to reveal the densities, associations, and collaborations among the selected dimensions. With these characteristics, this research would shed light on the future studies of researchers and practitioners working in this field as a map of the literature of the selected period.

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Chapter 28
Blockchain Based Smart Contract Applications in Tourism Industry

Seda Karagoz Zeren and Engin Demirel

Abstract The main aim of the study is to design the bases of the blockchain system and the creation of smart contracts and to generate a new blockchain in the financial payment system. In the scope of the study, the technology under the blockchain system and smart contracts examined. In light of the information obtained, a reliable, transparent, accountable simplified blockchain data structure as a result of intensive use of data and goods can be used in smart contracts in the financial payment system in tourism enterprises. In this context, utilizing the smart contract system consisting of continuous growth and structured data, it will be possible to dispose of the intermediary institutions in the transfer fees that can be used as a priority in the financial payments system. Content analysis was used within the scope of the research and examples of smart contract projects in the tourism sector were examined.

28.1 Introduction

Based on the era in which Industry 4.0 applications became easier to access to the virtual world, crypto coins created with the support of the science of cryptography help to remove geographic boundaries in financial payments. The technologies used in the process of creating crypto coins created by decentralized distributed structures help to create innovations. Crypto coins are currencies that are independently validated by public and high-powered computers that are moving independently in a universal and irreversible recording system (Vigna & Casey, 2017). The Bitcoin cryptocurrency was first published in 2008 with the article" Bitcoin: Peer-to-peer Electronic Cash Payment System" published by the person or group under the pseudonym Satoshi Nakamoto. The Bitcoin currency is in a peer to peer decentralized system without the need for a government, bank or intermediary organization. This decentralized currency enables a person anywhere in the world to send digital

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currency to a human at another point (Prypto, 2018). During this process, an open-source bookkeeping record is used that allows peer-to-peer (P2P) operations to be seen. These bookkeeping records are available on the entire P2P network. These records are sent to the member pool called "Mempool" after being approved by the miners. This process of work proof is called—POW. Following the approval of the pending transactions in Mempool, this record is written to the Blockchain. With each new transaction, the blocks are developed, and the related information is recorded in the network (Nebil, 2018). Fig. 28.1 shows the central and decentralized distributed notebook structure, while Fig. 28.2 discusses the blockchain structure.

When the blockchain structure is examined, it is seen that each of the blocks consists of a Hashed and coded stack. Each block contains the cryptologically encrypted hash function of the previous block. These blocks are encoded as Merkle Tree. Hash functions provide a small amount of information by using mathematical data. The Hash functions used in the blockchain structure include the SHA-256 algorithm. No matter how large the data is in the SHA-256 algorithm, the summary data always occupies 256 bits (https://www.getrevue.co, 17.01.2019). The information contained in the blockchain structure is passed through the secure hash algorithm, and the block hash is obtained. Each block contains the summary data of the previous block and uses this data in its summary data. In this way, changes in the structure of the blocks connected depend on the modification of the entire structure (https://www.risklabtr.com/, 17.01.2019). In this case, transparency is ensured in transactions.

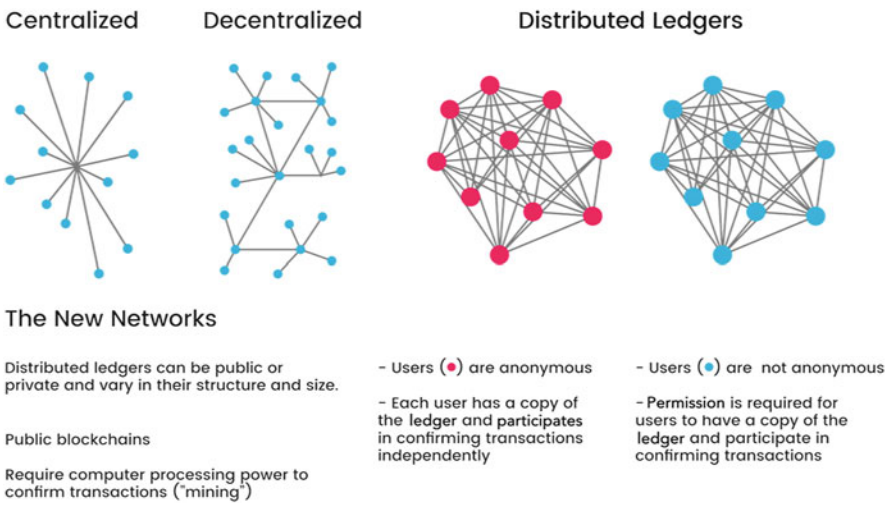

Fig. 28.1 Centralized-decentralized distributed ledgers. Source: https://blockgeeks.com/guides/what-is-blockchain-technology/, 17.01.2019

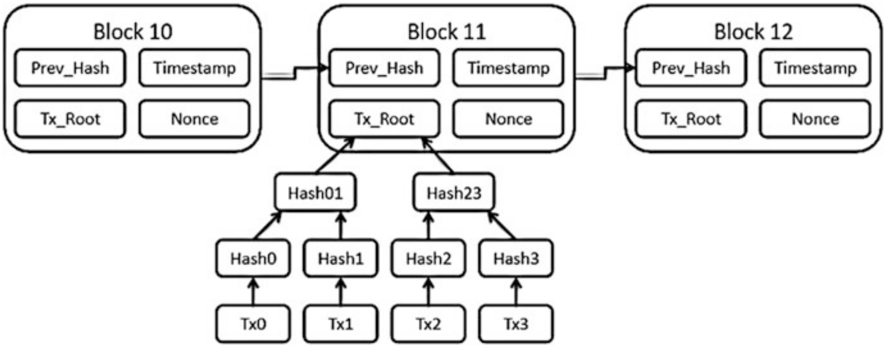

Fig. 28.2 Blockchain structure. Source: https://en.wikipedia.org/wiki/Blockchain#/media/File:Bitcoin_Block_Data.svg, 17.01.2019

The possibility of forming an attacker's blockchain that will be an alternative to an honest blockchain in a blockchain is discussed mathematically in Satoshi Nakamoto's article. In this case, even if the creation of an alternative attacker's chain to an honest chain is achieved, there is a defense system against the existence of money from the system or the possession of unpaid money. The competition between the attacker's and honest blockchain is described as Binomial Random Walk. In the case where the honest chain succeeds, the chain passes the +1 point forward, and one block extends, in case of failure, the chain of the attacker extends one block and the difference decreases by -1 point (İnci & Alper, 2018). The possibility of closing this delay difference is likened to the problem of the Gambler's Ruin. In this problem, the gambler is assumed to start playing with an unlimited balance of debt and has the right to an endless trial to reach an equal level. The likelihood of the gambler reaching the draw or the probability of the attacker capturing the honest chain can be calculated. In this case, it can be shown with mathematical expression (Nakamoto, 2019; Feller, 1957):

p = probability an honest node finds the next block
q = probability the attacker finds the next block
q_z = probability the attacker will ever catch up from z blocks behind

$$q_z = \left\{ \begin{array}{ll} 1 & , \quad p \le q \\ (q/p)^z, & \quad p > q \end{array} \right\} \tag{28.1}$$

Nakamoto published in the article used in the determination of the number of blocks in the mathematical expression used to increase the number of blocks that the attacker should capture $p > q$ expressed that the probability will decrease exponentially. If the honest node does not make an early move in case of an attacker's winning, he will fall behind the attacker. Based on these statements, it is examined how long the recipient initiates a new transaction before making sure that the sender will not change the transaction. This statement assumes that the sender is the attacker who is thought to have paid his money for a period of time and is asked to pay back after a period of time. The receiver will be warned when creating these operations. The recipient creates a new key pair for transactions and issues the public key to the sender shortly before signing. This key operation prevents the attacker from working in this time to prepare a block chain and perform the rollback at that time. After the transaction is sent, the attacker starts to sneak in a parallel block chain containing an alternative version of the sender, and the receiver waits until the process is connected to the process block and the z blocks are connected to the created block. Assuming that the honest node blocks take the average time per block, the attacker cannot know exactly the amount of progress he has made, while the expected value of potential progress can be determined by the Poisson distribution. This distribution is as follows (https://protiguous.com, 01.02.2019):

$$\lambda = z\frac{q}{p} \tag{28.2}$$

In order to find the probability of the progress of the attacker's sender, the Poisson density was multiplied by the probability of the progress made by the attacker from that moment on. In this case, the following formula was obtained:

$$\sum_{k=0}^{\infty} \frac{\lambda^k e^{-\lambda}}{k!} \cdot \begin{Bmatrix} (q/p)^{(z-k)} & , & k \le z \\ 1 & , & k > z \end{Bmatrix} \tag{28.3}$$

The rearrangement formula obtained in order not to sum the infinite tail in the Poisson distribution is given in (28.4):

$$1 - \sum_{k=0}^{z} \frac{\lambda^k e^{-\lambda}}{k!} \cdot \left(1 - (q/p)^{(z-k)}\right) \tag{28.4}$$

The conversion of the Poisson distribution, which is expressed mathematically, to C code is shown in (28.5):

```
#include < math.h>
double AttackerSuccessProbability(double q, int z)
{
double p = 1.0 − q;
double lambda = z ∗ (q / p);
double sum = 1.0;
int i, k;
```

$$for\ (k = 0; k <= z; k++) \tag{28.5}$$

```
{
double poisson = exp(−lambda);
for (i = 1; i < = k; i++)
poisson ∗ = lambda / i;
sum − = poisson ∗ (1 − pow(q / p, z − k));
}
return sum;
}
```

When the mathematical expression written with C code is executed by giving different values to q, z values and p values are obtained (https://protiguous.com, 01.02.2019):

$q = 0.1$	z values	p values
	0	1.0000000
	1	0.2045873
	2	0.0509779
	3	0.0131722
	4	0.0034552
	5	0.0009137
	6	0.0002428
	7	0.0000647
	8	0.0000173
	9	0.0000046
	10	0.0000012
$q = 0.3$	0	1.0000000
	5	0.1773523
	10	0.0416605
	15	0.0101008
	20	0.0024804
	25	0.0006132
	30	0.0001522
	35	0.0000379
	40	0.0000095
	45	0.0000024
	50	0.0000006

Solving for p less than 0.1%...

$p < 0.001$	q values	z values
	0.10	5
	0.15	8
	0.20	11
	0.25	15
	0.30	24
	0.35	41
	0.40	89
	0.45	340

Bitcoin has found its application with the Ethereum Blockchain proposed by Vitalik Buterin which is not only used in the financial field but also all areas. The most significant difference of the Ethereum blockchain from the Bitcoin blockchain is the creation of smart contracts on this platform. Another difference is that the consensus algorithm in the operations is running in the Ethereum blockchain as a PoS-Proof of Stake while working with the PoW-Proof of Work in the Bitcoin blockchain system. These operations aim to prevent the miners from forming blocks on top of each other. In the PoW method, a problem is defined as the summary value generated by the SHA-256 Hash function for a computer solution in a certain range.

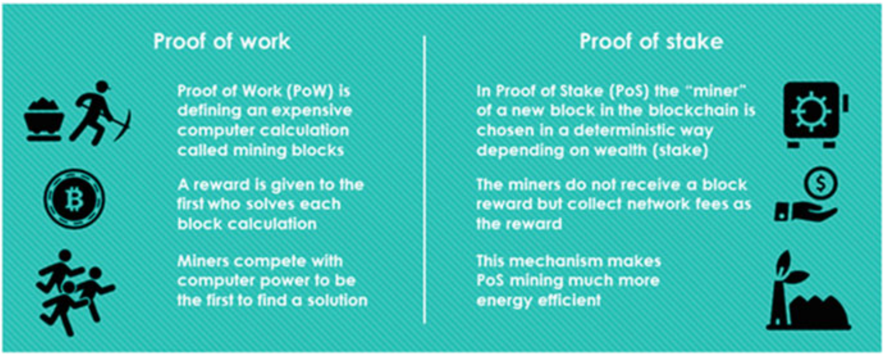

Fig. 28.3 Proof of work and proof of stake. Source: https://cryptotechies.com/proof-work-proof-stake/, 17.01.2019

In miners, they try to find this value by trial and error. In the PoS method, the miners do not compete with each other on the computational power, and the miners take on the task of forming blocks to the extent that they have a share in the system. The PoS method is used in the Ethereum blockchain. In this method, the miners record the ethers they have in a given pool, and the production of the next block is given to one of the miners with a random function. In this system, the miner does not win prizes and earns the transaction commission within the block. These miners are called "forger."

According to PoW method, energy consumption advantages are observed (Güven & Şahinöz, 2018). These differences between the PoW and PoS methods are shown in Fig. 28.3.

Zhang and Jacobsen (2018) collected the blockchain layer in 6 main headings. These layers (Zhang & Jacobsen, 2018);

- Application Layer
- Modeling Layer
- Contract Layer
- System Layer
- Data Layer
- Network Layer

One of the layers that make up the blockchain ecosystem is the layer where smart contracts are created. Reusable services and middleware components can be expressed as smart contracts and integrated between industries. This ecosystem is shown in Fig. 28.4.

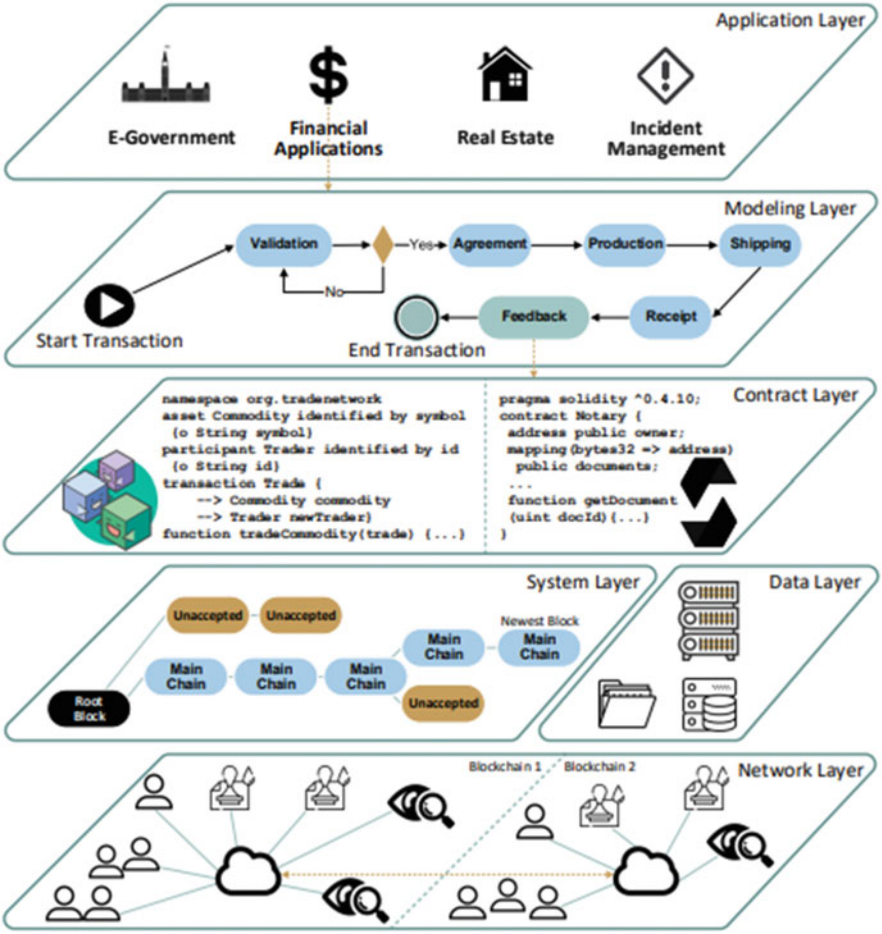

Fig. 28.4 Blockchain ecosystem. Source: Zhang, K., & Jacobsen, H. (2018). Towards dependable, scalable, and pervasive distributed ledgers with blockchains. 2018 IEEE 38th International Conference on Distributed Computing Systems (ICDCS). Vienna, Austria: IEEE. p. 7

28.2 Smart Contract

Smart contracts were created by coding standard contracts with encryption techniques without intermediary institutions and organizations. Smart Contracts were first proposed in 1996 by Nick Szabo, an academic computer expert, legal scholar and cryptograph who did research on digital contracts and digital currencies and later developed by Vitalik Buterin. *Nick Szabo, in 1996, described a smart contract as "a set of promises, specified in the digital form, including protocols within which the parties perform on these promises. . .*" (https://medium.com/, 18.01.2019). With the support of Bitcoin's blockchain technology, Ethereum block can also be formed in the chain base. In a blockchain summit, Vitalik Buterin described how smart contracts work: "Contracts are converted to computer language and saved to blocks. One hundred percent of the parties are kept in contracts that are copied to distributed books. The code particle is waiting for hibernation by specifying specific tasks and details (such as time limit, where to go and what to do). When the time comes, it takes action to, and if the necessary conditions are met, the transaction is completed successfully or canceled before it is completed" (https://webrazzi.com/, 19.01.2019). Investors define the smart contracts as follows: Smart contracts are contracts that fulfill the terms of the contract for writing the contract between the buyer and the seller directly on the lines of code. The laws and treaties here are found in a distributed, decentralized blockchain network. Smart contracts allow reliable transactions and agreements to be made between different, anonymous parties without the need for centralized authority, a legal system, or an external implementation mechanism. They make transactions observable, transparent and irreversible (https://medium.com/, 18.01.2019). In 2013, Vitalik Buterin reported the Ethereum blockchain infrastructure, an application that would take the bitcoin infrastructure beyond financial use. He received a Thiel Fellowship of $100,000 in 2014 for his project and began to develop Ethereum by collecting $18 million in the crowdsourcing campaign. There is also an organization called Enterprise Ethereum Alliance-EEA with more than 250 members. Among the founding members of this organization are JP Morgan Chase, IBM, and Microsoft (Nebil, 2018). The difference between the Ethereum blockchain and the Bitcoin blockchain, which makes the smart contracts work, is that the system developers can encode their programs. In the Ethereum statement, these people are called "autonomous agents" (Güven & Şahinöz, 2018). Smart contracts work on a virtual computer called Ethereum Virtual Machine. There are miners in this system and every time a change occurs in the case of smart contracts a network of computers processes and saves. EVM has its programming language. These programming languages include Solidity and Serpent. In other words, EVM is called a system that creates smart contracts, reads operations and performs operations. Smart contracts (https://www.coindesk.com/, 18.01.2019);

- They work as multi-signed accounts. Funds transfer is confirmed by the agreement of a certain percentage.
- Manage contracts that can be realized between users such as insurance policies.
- It can provide the operation of the software program as well as other conventions.
- Can store information about the application, such as a domain registration or a membership record.

Interpersonal money transfer transactions are smart contracts. For example, a person can transfer money by transferring $100 money to another person by writing a smart contract in EVM. Likewise, once a buyer has approved the delivery of a package, the transfer of funds to the seller can be generated by smart contracts. These examples are shown in Figs. 28.5 and 28.6.

The mathematical formulas used to form a block in the Ethereum blockchain can be expressed as follows (Wood, 2014):

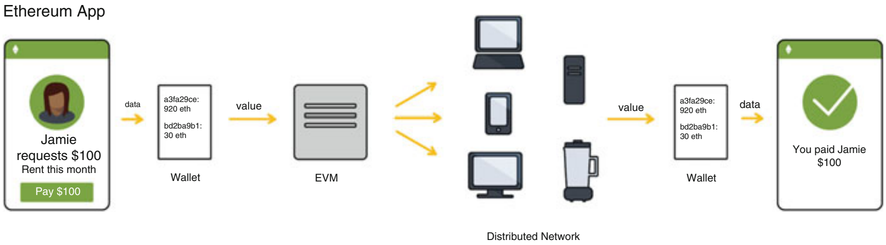

Fig. 28.5 Money transfer with smart contract. Source: https://www.coindesk.com/information/ethereum-smart-contracts-work, 18.01.2019

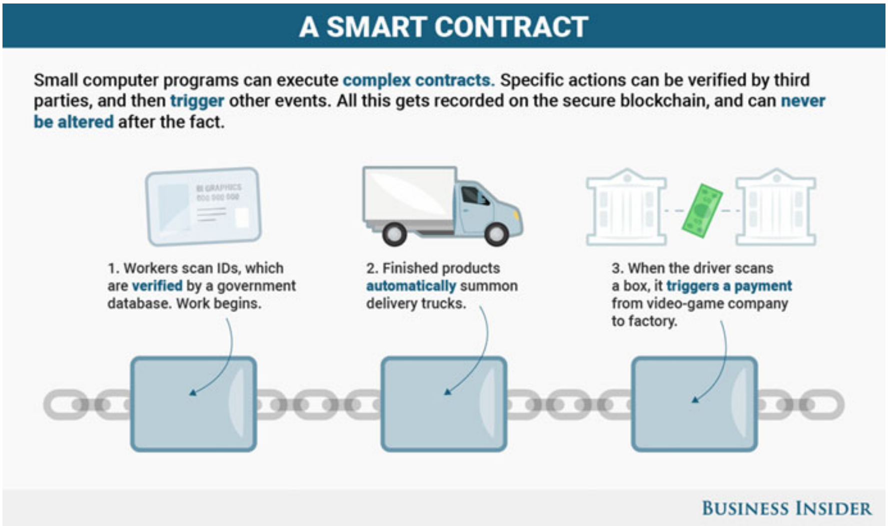

Fig. 28.6 Trading with smart contract. Source: https://medium.com/pactum/what-is-a-smart-contract-10312f4aa7de, 18.01.2019

Formula:

$$\sigma_{t+1} = \Upsilon(\sigma_T, T) \tag{28.6}$$

In formula (28.6), the ϒ function constitutes the ethereum state transition function. In the Ethereum, the σ function with ϒ is more powerful than any comparable system available. The ϒ function allows the components to perform random calculations, while the σ component allows them to record random states between operations. The processes are collated into blocks and the blocks are chained as a reference medium using a cryptographic hash. It records a series of operations and complementary operations with the previous block while the blocks function daily. The nodes in the process series are narrowed to the points where the miners are encouraged. This incentive adds value to a specified account as a state-transition function. The mining process consists of the process of separating the effort to create a series of processes on potential competing blocks. The blocks are obtained by means of a cryptographically reliable proof. If Formula (28.6) is expanded, Formula (28.7, 28.8, and 28.9) is obtained. Where is the Ethereum state transition function:

$$\sigma_{t+1} = \pi(\sigma_T, B) \tag{28.7}$$

$$B \equiv (\ldots, (T_0, T_1, \ldots)) \tag{28.8}$$

$$\Pi(\sigma, B) \equiv \Omega(B, \Upsilon(\Upsilon(\sigma, T_0), T_1) \ldots) \tag{28.9}$$

Where Ω is the terminating block state transition function (a function that rewards an assigned lot); B is a block that includes a series of operations among some other components, and Π constitutes a block-level state transition operation. These mathematical expressions form the basis of the block chain paradigm, which is the basis of the Ethereum block chain as well as a decentralized consensus-based processing system.

The coding of smart contracts with blockchain technology can also be created on platforms outside the Ethereum platform. The difference between these platforms is that the programming languages used are different, and they are dissimilar from the algorithms they provide by encrypting them with the private key. These platforms can be expressed as follows (Demirel & Karagoz Zeren, 2019):

- **Bitcoin Platform:** It is the platform on which smart contracts are created by adding OPRETURN command to work done on the Bitcoin blockchain. This command has been designed to ensure that the Bitcoin blockchain, which is the basis of the creation of the smart contracts, is used to transfer money and operate it outside the financial transactions.
- **NXT Platform:** The programming language used in this platform is Turing-Complete. It is the platform that allows everyone to create a smart contract with encryption by the public key.
- **Counterparty Platform:** A smart contract creation platform without its blockchain and written on the Bitcoin blockchain. Proof-of-burn network nodes have a system that does not charge for executing smart contracts.
- **Monax Platform:** A platform that allows users to create smart contracts without having their currency.
- **Lisk Platform:** This platform is a platform with open key cryptography to build smart contracts with its currency. One hundred one delegates selected by the stakeholders involved in the platform have the authority to produce blockchains.
- **Ripple Platform:** It is a platform that provides real-time payment system which is used to create smart contracts for banks and financial institutions.
- **Hyperledger Platform:** is the platform for building smart contracts with open source large projects such as Fabric and SawtoothLake, managed by the Linux Foundation.
- **Stellar Platform:** A platform that does not require a particular programming language for the creation of public open source and smart contracts with its own currency.
- **Multichain Platform:** It is the platform execute by organizations used for asset management to create smart contracts among themselves.

Figure 28.7 shows the greeting smart contract codes in which the contract can be rendered unusable by the person adding the contract only.

```
pragma solidity >=0.4.22 <0.6.0;

contract Mortal {
    /* Define variable owner of the type address */
    address owner;

    /* This constructor is executed at initialization and sets the owner of the contract */
    constructor() public { owner = msg.sender; }

    /* Function to recover the funds on the contract */
    function kill() public { if (msg.sender == owner) selfdestruct(msg.sender); }
}

contract Greeter is Mortal {
    /* Define variable greeting of the type string */
    string greeting;

    /* This runs when the contract is executed */
    constructor(string memory _greeting) public {
        greeting = _greeting;
    }

    /* Main function */
    function greet() public view returns (string memory) {
        return greeting;
    }
}
```

Fig. 28.7 Greeting smart contract. Source: https://ethereum.org/greeter, 02.02.2019

28.3 Smart Contract Application in Tourism Industry

The tourism sector is one of the labor-intensive sectors. In this sector, intermediary institutions are very important. The labor, time and wages spent on intermediary institutions increase the cost of the service produced in the sector and the time cannot be used efficiently. With the development of technology, blockchain system and the creation of smart contracts are aimed to meet the consumer directly with the service provider by eliminating the intermediary institutions in this sector or by reducing the dependence on intermediary institutions. Smart contracts created within this scope will provide speed and cost advantage. In addition, transparency and reconciliation will be ensured in the process as a result of the formation of transactions by blockchain technology. With the increase in interest in smart contracts, many projects are tried to be created in the tourism sector as in every field.

28.3.1 Smart Contract Projects

When the examples of using smart contracts in the tourism sector are examined, it is seen that there are studies carried out to facilitate payment and transactions between airline companies and travel agencies. Examples of these studies are the project

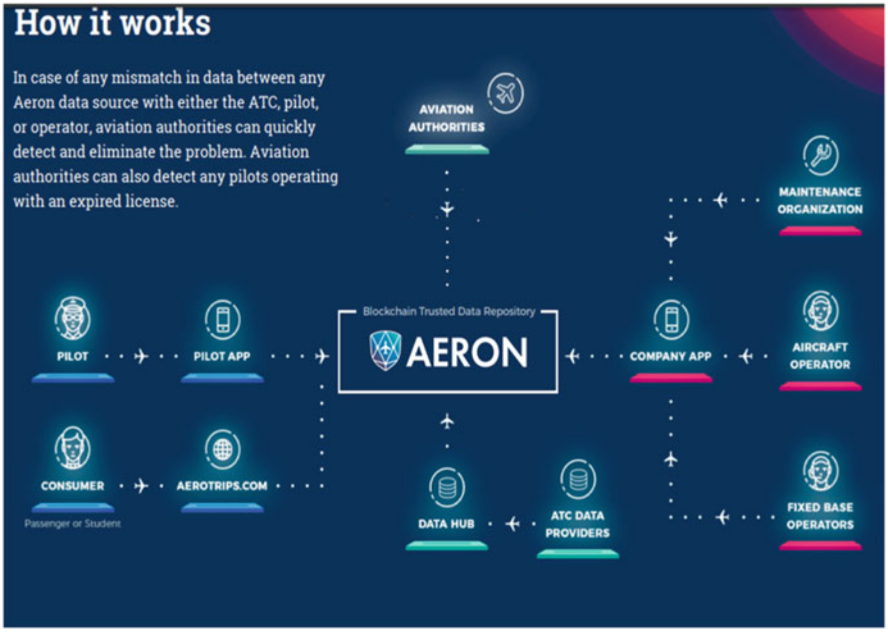

Fig. 28.8 Aeron blockchain. Source: https://i.aeron.aero/storage/AeronWhitepaper.pdf, 02.02.2019

carried out by Aeron (ARN). They have created a plan by using the blockchain method to eliminate the accidents caused by a human factor in transportation by air transportation. The general purpose of the Aeron is to create a blockchain pool consisting of applications that can be used by pilots, aviation companies and passengers separately to prevent manipulations on flight times and documents. (https://hwp.com.tr/, 02.02.2019). The working principle of the project that Aeron has established with the aim of security is shown in Fig. 28.8. The benefits of the application in terms of pilots; flight hours tracking, transparency, and compliance in aviation operations, benefits provided in pilot schools, discounted fixed base operations payment with crypto money method and membership on the website of aerotrips.com. The benefits of implementation for companies; monitoring of the appropriate diaries, transparency provided in aviation operations, easy to follow up, secure aircraft reservation system, aircraft management and maintenance of the benefits to be presented, the application can be stated as the introduction of new customer entrances. Benefits of this application for passengers; ease of access to the global flight database, air taxi, and rental operations, flight tours and nights can be arranged, providing flight experience with pilots who have proven flight training and professional competence, cryptocurrency payment transactions can be realized and membership on the website of aerotrips.com.

Another application example in airline companies is carried out by the Singapore airline. There is a crypto money production project called KrisPay, which Singapore airline has initiated under the name Digital Wallet. KrisFlyer users who are members of the Singapore airline's loyalty program can use 18 different deal points by instantly converting the miles accumulated in their accounts to KrisPay. Esso, Shangri-La Hotel Singapore, and Passenger are among the first business partners of KrisPay. Also, Singapore Airlines worked with KPMG Digital Village and Microsoft in this project. Thanks to this program, some of the advantages of the airline company are: being able to follow the first company feature to implement the blockchain, and to be able to carry out transactions without completeness and intermediation (https://www.havayolu101.com, 02.02.2019). The use of KrisPay is shown in Fig. 28.9 in four steps.

Another example of the implementation of blockchain-based smart contracts is the CryptoBnB application, which can process as Airbnb accommodation site. CryptoBnB can also perform all transactions that can be completed on the Airbnb site. It offers a platform where short term rentals and smart contracts can be established. CryptoBnB will provide transparency in transactions using the CryptoDNA protocol, combining block and smart contracts, artificial intelligence and big data processing. An example of a CryptoBnB application is shown in Fig. 28.10.

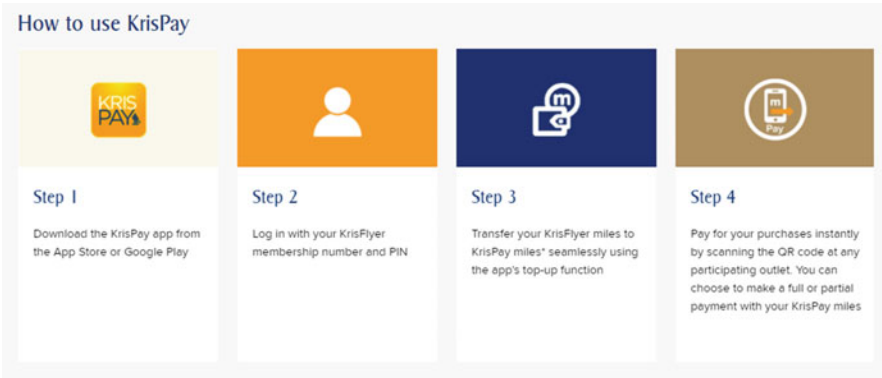

Fig. 28.9 Singapore Airlines blockchain. Source: https://www.singaporeair.com/en_UK/us/ppsclub-krisflyer/use-miles/krispay/, 02.02.2019

Fig. 28.10 CryptoBnB. Source: https://cryptobnb.io/, 02.02.2019

28.4 Conclusion

When the effects of technological innovations on sectors are examined, it is seen that the tourism sector is affected by these innovations. Among the innovations to be provided in the tourism sector with blockchain technology, it is seen that the benefits of customer loyalty programs, customer follow-up systems, travel business and airline companies and the benefits to be provided in accommodation transactions. The use of smart contracts to be created with the use of blockchain technology provides transparency in transactions and facilitate true reconciliation of agreements. When the sector-based analysis of the increasing interest in smart contracts is made, it is seen that these practices are in the development stage in the tourism sector and various projects are tried to be realized. In this respect, the creation of smart contracts in the tourism sector can be seen as a new academic point of view for future enterprises.

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Chapter 29
Bitcoin Jumps and Speculations: Empirical Evidence from High-Frequency Data

Abdullah Yalaman

Abstract The aim of this chapter is to investigate the relationship between the jump dynamics of Bitcoin prices and the speculations by using high-frequency data. I measure the significance of the jumps using Huang and Tauchen (*Journal of Financial Econometrics*, *3*, 456–499) nonparametric test and Google's Trends statistics for the measurements of the speculation. Since the futures contracts on Bitcoin transactions plays significant effect on its volatility, therefore, this paper additionally tests the effect of the futures contracts on this relationship. The results show that there is a discrete jump in the Bitcoin price around speculations and the futures contracts do not have any significant effect on this relationship, but notably after the launch of futures contract, the speculations have much higher significant effect on the Bitcoin jumps.

29.1 Introduction

Bitcoin is defined as decentralized and peer-to-peer electronic currency system that allows the transactions to be non-reversible via cryptographic treatment of transaction information (Nakamoto, 2008). Bitcoin is not issued by any government or financial institution. Bitcoin payment system is a completely decentralized system that allows a transaction to happen without an intermediate of a third party. Bitcoin payment system provide a timestamped public ledger of transaction in chronological order that grant protection for both buyers and sellers in their transactions.

Bitcoin was innovated in 2008 (Zhu, Dickinson, & Li, 2017) but it was practically first applied by Satoshi Nakamoto on 3rd Jan 2009 when he minded 50 Bitcoins trying to explain the mining method to an online listener. According to Crane (2017), New Liberty Standard published the first USD/BTC exchange pair for 0.076 of a cent. According to Bonneau et al. 2015, the first shopping with Bitcoin was made on 22 May 2010 when someone purchased two pizza for ten thousands of Bitcoins.

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Since then, Bitcoin received people's attention and in July 2010, an online trading platform was established for trading Bitcoin called Mt. Gox and 20 Bitcoins were traded on the first day for 4.951 cents each (Warner, 2018).

Later people from around the world got familiar with cryptocurrency and due to sending and receiving any amount of money to/from anyone with lowest cost, the trading volume in Bitcoin increased quickly. On 14 Dec 2017, the daily transaction jumped to 490,459 transactions. According to CNBC, the number of mined Bitcoins has increased from 5.25 million Bitcoins in 2011 to 17 million Bitcoin in April 2018 (Cheng, 2018) and the price of BTC/USD has grown from \$0.06 on 30 June 2010 to \$19,783.06 in 17 Dec 2017. But Bitcoin couldn't maintain its price at this level and 1 year later it dropped to \$3206 on 15 Dec 2018.

Internal Revenue Service of USA consider Bitcoin as a capital asset and impose capital gain tax when sold (Warner, 2018). Like any other normal assets, Bitcoin also experience volatility but the volatility of Bitcoin is too extreme in compare to normal assets. According to Yermack (2015), in comparison to normal currency pairs and stocks, the volatility in BTC/USD was 142% while the volatility for other currency pairs and stocks were between 7% and 12% and 20% to 30% respectively. Baur and Dimpfl (2017) report that Bitcoin experience extreme volatility up to 30 times larger than normal assets.

In recent years, the developments in Bitcoin have received a lot of attention from academician and practitioners and a number of empirical studies have been conducted on Bitcoin characteristics. For example, Lo and Wang (2014) study the monetary characteristics of Bitcoin and examine whether it can serve the money purpose. Yelowitz and Wilson (2015) analyze the characteristics of individuals interested in Bitcoin through employing Google trend search data. The authors' findings show that computer programmers and criminals are likely to be particularly interested in this cryptocurrency. Yermack (2015), studies the monetary characteristics of Bitcoin and finds that in comparison to normal currency pairs, the volatility in Bitcoin is 142% while the volatility for other currency is between 7 and 12% and that there is "virtually zero correlation" with gold prices.

Gronwald (2015) studies the dynamics of Bitcoin prices i.e. volatility clusters and extreme price movements, through applying an autoregressive jump-intensity GARCH model. The author finds that the dynamics in Bitcoin price are similar to other markets and there is evidence of both volatility clusters and extreme price movements. Moreover, Bitcoin prices show sensitive to news than the prices in other markets. Guegan and Frunza (2018) analyze the existence of bubble effects in Bitcoin market during different period of time. They find that Bitcoin prices had two incidents of unexpected inflation in 2014 and 2017. McWharter (2018) studies whether the media is one of the driver of the volatility in Bitcoin prices. By employing GARCH model, the author finds that the volatility in Bitcoin prices is mainly correlated with Google trends. Moreover, negative news seem to have a significant positive correlation with Bitcoin volatility. Chaim and Laurini (2018) analyze the dynamics of Bitcoin daily returns and volatility for the period of May 2013 to April 2018. The authors use standard lognormal stochastic volatility model and find that Bitcoin displays patterns of unconditional volatility and discontinuous return jumps. Events such as Mt. Gox incident and the hack of the Bitcoin protocol and unsuccessful fork attempts are likely the drivers of large volatility and mean jump. Scaillet, Treccani, and Trevisan (2017) use the leaked Mt. Gox high-frequency database to inspect the dynamics of Bitcoin price for the period from June 2011 to November 2013. The authors findings suggest that jumps are frequent events and cluster in time. Bouri, Azzi, and Dyhrberg (2016) use daily data to study the connection between returns of Bitcoin and its volatility. Their findings show no proof of any asymmetric return-volatility relationship. However, there is a significant inverse relation among past shocks and volatility before the Bitcoin crash in 2013.

Sahoo, Sethi, and Acharya (2019) use the daily returns, trading volume, volatility of returns for the period 2010–2017 to examine the price volume relationship in the Bitcoin market. They employ linear and non-linear causality tests for examining the price and volume relationship. The authors find that the trading volume in bitcoin cannot be a good proxy to predict the returns in Bitcoin prices. But the reserve causality factor seems to be significant. On the opposite, the authors' non-linear causality analysis indicates the existence of non-linear relationship between the returns of bitcoin and trading volume.

Using of high-frequency data has many advantages. Besides improving modeling of volatility, high-frequency data make us possible to divide volatility into its base component as continues and jump part. Continues part represent pure Brownian motion process while jump part represent poison process (Aït-Sahalia & Jacod, 2012; Saleem & Yalaman, 2017). Moreover, high-frequency data improves the estimation of price volatility (Andersen, Bollerslev, Diebold, & Ebens, 2001; Yalaman & Saleem, 2017). Engle (2000) is regarded as the starting point for a fast growing body of research in high-frequency financial econometrics. Likewise, other researchers who use high-frequency data certify that the realized volatility is estimated more precisely with intraday returns than with daily returns (Andersen et al., 2001; Barndorff-Nielsen & Shephard, 2004; Liu, 2009; Yalaman & Saleem, 2017).

High-frequency data also helps in measuring the impact of news on stocks returns. The reaction of assets' prices to news is short-lived and are hard to be identified on daily or other lower frequency bases (Han, 2008; Lahaye, Laurent, & Neely, 2011). Assets adjust their prices to new information within the first few minutes following an information released (Ederington & Lee, 1993: Bollerslev, Cai, & Song, 2000). Therefore, it is important to use intraday data instead of daily data in studying the responses of price to news. Kang and Kim (2019) studies the characteristics of jumps in Bitcoin prices. The authors use non-parametric econometrics to break down the pricing process in Bitcoin prices into jump and continuous components. In other words, they divide the return of Bitcoin into a jump return and a continuous return. They find that the jumps in Bitcoin prices are independent of volatility and the jumps in Bitcoin prices do not occur at regular intervals. The authors observe that most of the jumps happen at the time when trading volume is too low. According to Kang and Kim (2019), identifying the jumps in assets prices is essential for asset pricing and risk management. The jump diffusion model is used by Philippas, Rjiba, Guesmi, and Goutte (2019) to study the impact of attention in social media on Bitcoin prices. The authors find that the attention and the discussion on the Bitcoin in the social media networks have significant impact on Bitcoin prices. They present the frequeny, the direction and the intensity of jumps caused from social media networks attention. Wang, Liu, Chiang, and Hsu (2019) use daily data to forecast out-of-sample volatility for Bitcoin returns using ARJI, GARCH, EGARCH, and CGARCH models from the period of 2013–2019. The authors find that ARJI jump model outperformance other forecasting models both in-sample and out-of-sample forecasting performance. Yu et al. (2019) use high-frequency data to study the leverage effect and economic policy uncertainty on one-step-ahead Bitcoin price volatility. The authors find that the leverage effect have statistically significant effect on volatility. Shrestha (2019) uses Multifractal Detrended Fluctuation Analysis (MF-DFA) and bipower variation method to examine the market efficiency of Bitcoin. The author finds that with the bipower variation method, the Bitcoin market is efficient while with MF-DFA the Bitcoin market is not efficient since the Bitcoin returns are multifractal. Matkovskyy (2019) compares the return volatility and interdependency of EUR, U.S. dollar, and GBP centralized and decentralized bitcoin cryptocurrency markets. The author finds that the centralized markets have higher tail dependence whereas the decentralized bitcoin market has higher volatility.

Thus the present chapter differs from previous studies in aspects of the followings: No previous study investigates the jump behavior of cryptocurrency market around the speculations. Most of the previous studies used daily data to detect the association of Bitcoin price with the news or other macroeconomic variables (Buchholz, Delaney, Warren, & Parker, 2012; Dyhrberg, 2016; Kristoufek, 2015) while we use high-frequency data. Most of the previous studies used high frequency data to detect the relationship between stock price jump and news or other macroeconomic variables (Huang, 2018; Maheu & McCurdy, 2004; Saleem & Yalaman, 2017) while we use the jump dynamics of Bitcoin price. Lastly, it is known that there is a decrease in Bitcoin volatility after the introduction of futures contracts.[1] Thus, this paper additionally test the effect of futures contracts of Bitcoin on this relationship. The results show that there is a discrete jump in the stock price around speculations on Bitcoin price and the futures contracts have no significant effect on this relationship, but notably after the launch of futures contract, the speculations have much higher significant effect on the Bitcoin jumps. Our study benefit those individuals who are interested or engaged in portfolio management, risk management, options and bond pricing and hedging in cryptocurrency markets.

The chapter is designed as followings: in Sect. 29.2, we discuss the methodology of jump detection process. In Sect. 29.3 we present the data. Section 29.4 offers empirical findings and Sect. 29.5 presents the conclusion.

[1]The CME Group contract began trading on December 18, 2017. The contract is cash-settled, based on the CME CF Bitcoin Reference Rate (BRR) which serves as a once-a-day reference rate of the U.S. dollar price of bitcoin. Bitcoin futures are listed on and subject to the rules of CME (see https://www.danielstrading.com/bitcoin-futures).

29.2 Cryptocurrencies and Bitcoin

Cryptographic safe operation is called Cryptocurrencies. Cryptocurrencies are alternative currencies, they are digital and also virtual money. Frequently, digital and virtual coins are mixed with Bitcoin and its derivatives. Digital and virtual currencies other than bitcoin and its derivatives are not currency in themselves; they are based on the national currency of a country and can be regulated and controlled by the central authorities of that country. Bitcoin in itself is a currency, cannot be controlled by any central authority. Cryptocurrencies are decentralized. Control of this decentralized structure is performed by Block-Chain (BlockChain) transaction databases. Cryptocurrencies are produced by publicly known methods at rates determined at the establishment stage of the system. There is a third institution that is trusted in traditional electronic money system and transfer operations, but there is no third party institution in crypto systems since the trust is not necessary. The system is reliable (Çarkacioğlu, 2016).

There are many different definitions of Bitcoin. For example, Satoshi Nakamoto (2008) define Bitcoin as a purely peer-to-peer version of electronic cash that would allow online payments to be sent directly from one party to another without going through a financial institution. Antonopoulos (2014) express Bitcoin as a collection of concepts and technologies that form the basis of digital money ecosystems. Böhme, Christin, Edelman, and Moore (2015) indicate that Bitcoin is an online communication protocol that facilitates the use of a virtual currency, including electronic payments. It is clear that Bitcoin is a set of concepts and topics that make up the digital money economy. The Bitcoin system consists of an open source software. The software runs on a wide range of processors, including laptop and smartphone. It is completely digitalized and does not need physical representation. Because of the fact that the transaction costs are very small, can be used globally, the usage areas are increasing day by day, and since it is a safe and anonymous value storage tool, Bitcoin is becoming more popular.

Bitcoin can be divided up to eight digits, 0.00000001 Bitcoin operation is possible. The smallest Bitcoin is called Satoshi. In other words, 100 Million Satoshi is 1 BTC. Although the theories of Bitcoin are quite technical, they are very easy to use. You can immediately install any of the wallet programs, buy and sell Bitcoins and transfer them. Bitcoin wallets are programs that store the Bitcoins owned by people and allow processing on them. Bitcoin can be exchanged with US Dollars, Euros or any other currency at any time. As with the use of normal money, Bitcoin users can send BTC to each other using the Bitcoin network to purchase or sell products/services. Bitcoin can buy and trade. Bitcoin pushes the boundaries towards a new virtual economy.

Bitcoin is not a company or institution, there is no management center, it does not belong to any person or institution, and there is no official representative. You can send Bitcoin to someone else by using your computer or mobile phone in a matter of minutes, free of charge, 24/7. No government and bank can block these funds. Bitcoin is not produced by a hub, the bitcoin supply is made with the processor powers of the voluntary computers in the decentralized global network. By running the open-source miner software, anyone involved in the Bitcoin network can be miners and produce Bitcoin. The maximum number of BTC is limited to 21 million. No one, no authority can supply money to the Bitcoin system. However, the central authorities print the banknotes money and additional money supply is provided when requested. Since Bitcoin supply continues to decline, and there will be no Bitcoin supply after 2140, Bitcoin may be a deflationary currency. Since there is not enough Bitcoin, if the demand for Bitcoin increases, it will be over-valued. All transfer transactions since 2009 are kept in the global ledger called Block-Chain (Çarkacioğlu, 2016).

During the global financial crisis in 2008, countries suffered greatly. In order not to relive the Great World Depression in the 1930s, Central banks pressed money and reduced interest rates. Many banks were liberated from the brink of bankruptcy, but the cost of this recovery was reflected to the public as depreciation of currencies and tax increases. Bitcoin as a decentralized currency emerged in an environment in which trust in brokerage houses, banks and central banks, and even governments was reduced. Bitcoin was announced to the world with the article "Bitcoin: A peer-to-peer electronic cash system" by Satoshi Nakamoto. The innovation brought by Satoshi is that it has prevented double spending with a mechanism that confirms the transfer operations every 10 min using distributed processor powers. Bitcoin network, which was launch in 2009, has more power than the world's fastest computers.

29.2.1 Google Trends

With the rapid expansion of Internet and highly usage of Google search engine by the Internet explorers, Google started to publicize its users' search queries in 2009. The release of such information to the public has given both the researchers as well as the investors an opportunity to gather market intelligence without carrying out any high cost surveys. Google's Trends is an online search tool that allows the user to see how often specific Bitcoin keywords have been queried over a specific period. Many academic researchers has used Google Trends for research purposes. For example, Choi and Varian (2009) used Google Trends information shortly after the release of the Google Trends in 2009 to report the basic nowcasting models for unemployment claims in the United States can be improved by employing Google search queries. Moreover, some other researchers has used Google Trends to analyze if Google Trends could be used to predict downturn in real time. The authors find that many Google Trends indicators have predictive power in explaining downturn in real time.

29.3 Methodology

29.3.1 Testing the Presence of Jumps in Bitcoin Price

Aït-Sahalia and Jacod (2012) state that the log-price X_t follows a semimartingale process, such that

$$X_t = X_0 + \int_0^t b_s ds + \int_0^t \sigma_s dW + JUMPS$$

$$JUMPS = \int_0^t \int_{[|x| \le \varepsilon]} x(\mu - \upsilon)(ds_x, dx) + \int_0^t \int_{[|x| > \varepsilon]} x\mu(ds_x, dx).$$

It comprises a non-zero mean, drift, a continuous component with Brownian motion and a discontinuous component with a jump measure of X_t.

A more familiar form of this semimartingale process denoted as follows:

$$\mathrm{dX_t = \mu_t dt + \sigma(t) dw_t + K_t dq_t} \tag{29.1}$$

where X_t refers to continuous-time log-price process, μ_t stands for the drift, w_t is the Brownian motion independent of the drift and σ_t refers to the spot volatility which is càdlàg, q_t is the counting process independent of w_t and K_t is the logarithmic size of the jump size. $dq_t = 1$ if there is a jump at time t, otherwise $dq_t = 0$.

The implied discrete-time returns are estimated with the following formula:

$$\mathrm{r_t = X_t - X_{t-1}}, \qquad \mathrm{t} = 1, 2, \ldots \tag{29.2}$$

The continuously compounded M intra-daily returns for day t are estimated with the below formula;

$$\mathrm{r_{t,j} = X_{t,j} - X_{t,j-1}}, \qquad \mathrm{t} = 1, 2, \ldots, \mathrm{T}, \tag{29.3}$$

where $X_{t,\,j}$ is the jth intraday log-price for day t and T is the number of days.

The jumps statistic can be calculated as follows (see Barndorff-Nielsen & Shephard, 2004):

$$\mathrm{RV_t} = \sum_{j=1}^{M} \mathrm{r}_{t,j}^2, \xrightarrow[M\to\infty]{P} \int_{t-1}^{t} \sigma_s^2 ds + \sum_{s=qt-1}^{q_t} \mathrm{K}_s^2, \qquad \mathrm{t} = 1, 2, \ldots, \mathrm{T}. \tag{29.4}$$

$$\mathrm{BV_t} \equiv \mu_1^{-2} \sum_{j=2}^{M} \mid r_{t,j} \| r_{t,j-1} \mid, \quad t = 1, 2, \ldots, T. \tag{29.5}$$

where $\mu_1 is\ E(|Z|^a),\ \ Z \sim N(0.1),\ \ a > 0.\ \mu_1 = \sqrt{2/\pi} \simeq 0.79788$

When the sampling frequency runs to infinity, BV_t converges to the integrated variance as follows:

$$\mathrm{BV_t} \xrightarrow[M \to \infty]{P} \int_{t-1}^{t} \sigma_s^2 ds \qquad t = 1, 2, \ldots, T. \tag{29.6}$$

The jump component is calculated as follows:

$$\mathrm{RV_t} - \mathrm{BV_t} \xrightarrow[M \to \infty]{P} \sum_{s=qt-1}^{q_t} K_s^2, \qquad t = 1, 2, \ldots, T. \tag{29.7}$$

I use the ratio jump test with a sampling frequency of 1-min intervals for Bitcoin price, and critical value is 3.09. The jumps test statistic under the null hypothesis of no jump is as following:

$$J_t = \frac{\frac{RV_t - BV_t}{RV_t}}{\sqrt{\left[\left(\frac{\pi}{2}\right)^2 + \pi - 5\right] \frac{1}{M} \max\left(1, \frac{TP}{BV_t^2}\right)}} \xrightarrow{d} N(0.1), \tag{29.8}$$

where $\frac{RV_t - BV_t}{RV_t}$ is the jump ratio as defined by Huang and Tauchen (2005).

To test for significance of jumps, we use Tri-Power Quartricity ($\mathrm{TP_t}$) as following:

$$\mathrm{TP_t} \equiv M\mu_{\frac{4}{3}}^{-3} \left(\frac{M}{M-2}\right) \sum_{j=3}^{M} \left|r_{i,j}\right|^{4/3} \left|r_{i,j-1}\right|^{4/3} \left|r_{i,j-2}\right|^{4/3}, \qquad t = 1, \ldots, T, \tag{29.9}$$

where $\mu_{4/3} = 2^{2/3}\Gamma\ (7/6)/\Gamma(1/2) \approx 0.8309$.

The $\mathrm{RV_t}$ of the jump components is measured by the following:

$$J_t = I\left(z_{TQ,r,m,t} > \Phi_\alpha \cdot \left(RV_t - BV_{i,t}\right)\right) \tag{29.10}$$

where $I(\cdot) = 1$ if its argument is true, or 0 otherwise, and Φ_α show the critical value from the standard normal distribution in the upper α quantile.

29.3.2 Data

I downloaded tick-level trading data for Bitcoin from the Kaggle-Bitcoin Historical Data.[2] Tick level data include the price, volume and timestamp per tick. Exchanges included are Coinbase. Trading data are obtained against USD. The Bitcoin data range from February 2015 to November 2018, providing a comprehensive overview over Bitcoin trading. In this study we use the lowest possible interval prices such as 1-min interval in order to precisely capture jumps in Bitcoin prices and the relationship between these jumps and the Google Trends indicator. According to literature, high-frequency data such as 1-min intervals improves volatility estimation and volatility modeling. Moreover, it also enables us to divide volatility into continues and jump components. Since the reaction of assets' prices to news is short-lived, it is better to use highest level of frequency data.

Google's Trends statistics of Bitcoin based on the keyword of Bitcoin for all over the world in all categories which are used for the measurement of speculations. Google's Trends is an online search tool that allows the user to see how often specific Bitcoin keywords have been queried over a specific period.[3]

29.4 Empirical Findings

The purpose of this chapter is to investigate the relationship between Bitcoin jumps and speculation using high-frequency data. We apply Huang and Tauchen (2005) jump test using 1-min interval data to detect significant jumps in Bitcoin price and then to investigate the relationship between jumps and speculation. Because of the availability of the Google trend data in weekly basis frequency, we estimate the following model using logistic regression method based on the weekly basis period.

$$J_t = \beta_0 + \beta_1 Speculations_t + \beta_2 Rvol_t + \varepsilon_t \quad [\text{Model} - 1]$$

Where J_t represent significant discrete jumps in Bitcoin price, $Rvol_t$ represents Bitcoin price volatility calculated from sum of squared tick by tick prices for a daily basis period (see Eq. 29.4). $Rvol_t$ is used as a control variable in Model-1. I estimate the models using logistic regression method.

Table 29.1 show that there is a statistically significant positive relationship between Bitcoin jump in the price and speculations for the full sample period data. The Futures market contract of Bitcoin began trading on December 18, 2017 and since it is clearly known that these contract have significant effects on Bitcoin volatility, this paper additionally test the effect of futures contracts of Bitcoin on

[2] https://www.kaggle.com/mczielinski/bitcoin-historical-data#coinbaseUSD_1-min_data_2014-12-01_to_2018-11-11.csv

[3] https://trends.google.com.tr/trends/explore?q=bitcoin&geo=TR

Table 29.1 Estimation results for full sample period (For the period from 2/01/2015 to 11/04/2018)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Speculations	0.120842	0.026070	4.635291	0.0000
Rvol	−0.006775	0.008804	−0.769484	0.4416
Mean dependent var	0.939086	S.D. dependent var		0.239781
S.E. of regression	0.393271	Akaike info criterion		1.151093
Sum squared resid	30.15908	Schwarz criterion		1.184425
Log likelihood	−111.3826	Hannan-Quinn criterion		1.164586
Avg. log likelihood	−0.565394			

Table 29.2 Estimation results before the transactions on futures market (For the period from 2/01/2015 to 12/17/2017)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Speculations	0.080147	0.030601	2.619097	0.0088
Rvol	0.005239	0.009882	0.530136	0.5960
Mean dependent var	0.933775	S.D. dependent var		0.249503
S.E. of regression	0.427067	Akaike info criterion		1.278392
Sum squared resid	27.17559	Schwarz criterion		1.318356
Log likelihood	−94.51856	Hannan-Quinn criterion		1.294627
Avg. log likelihood	−0.625951			

Table 29.3 Estimation results after the transactions on futures market (For the period from 12/17/2017 to 11/04/2018)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Speculations	0.477106	0.146789	3.250273	0.0012
Rvol	−0.187977	0.060996	−3.081775	0.0021
Mean dependent var	0.957447	S.D. dependent var		0.204030
S.E. of regression	0.173848	Akaike info criterion		0.344455
Sum squared resid	1.360036	Schwarz criterion		0.423184
Log likelihood	−6.094687	Hannan-Quinn criterion		0.374081
Avg. log likelihood	−0.129674			

this relationship. Therefore, we divide our sample into two part as before the transactions on futures market (for the period from 2/01/2015 to 12/17/2017) and after the transactions on futures market (for the period from 12/17/2017 to 11/04/2018) and see the effect of futures contracts on the relationship between the jump dynamics of Bitcoin price and the speculations. The estimation results are presented in Tables 29.2 and 29.3 respectively.

According to Tables 29.2 and 29.3, there is a statistically significant positive relationship between jumps in Bitcoin prices and speculations similar to full sample estimation. We can conclude that the futures contract on Bitcoin have no significant effect on this relationship but the power of relationship can change. After the launch of futures contract, the speculations have much higher significant effect on the Bitcoin jumps.

29.5 Conclusion

The aim of this chapter is to measure the relationship between jump dynamics of Bitcoin price and speculations through using high-frequency data. This chapter measures the significance of jumps in Bitcoin price using Huang and Tauchen (2005) nonparametric test and Google's Trends statistics for the measurements of speculation. Google's Trends is an online search tool that allows the user to see how often specific Bitcoin keywords have been queried over a specific period. It is known that there is a decrease in Bitcoin volatility after the introduction of futures contracts. Therefore, this paper additionally tests the effect of futures contracts of Bitcoin on this relationship. The results show that there is a discrete jump in the stock price around speculations on the cryptocurrency market. Because we could capture a statistically significant relationship for both sub-sample period, thus we can conclude that the transactions of futures contract on Bitcoin have no significant effect on this relationship but the force of this relationship could change indicating higher significant speculations effect on the Bitcoin jumps after the starting period of transactions of futures contract on Bitcoin.

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Chapter 30
Taxing the 'Un'Taxed Digital Economy with a Focus on India: Decoding the Outsourced Holding Company Model

Sovik Mukherjee

Abstract In the backdrop of the digital revolution we are witnessing, value creation through conventional production of goods and services is being challenged every now and then. These days, the digital economy, from entertainment to shopping, forms a crucial part of millions and millions, but its value added is slipping through our grasp. The fact of the matter is that sizeable shares of the value additions these companies do are moved out of countries where corporate tax rates are high to the accounts of companies in tax havens. This means that the productivity gains achieved through the digital economy does not necessarily translate into increased tax revenues for the government. The big names in the digital business market, at present, have been accused of paying virtually no tax in those populous countries where they operate. For example, Google's revenue reached about US$74.5 billion in 2016 and yet Google is known to be subject to low effective rates of taxation and even accused of deferring taxes on revenues over US$24 billion only in the United States. Other European countries like Italy, France and others have proposed to tax the income of these digital entities but somehow it never materialized. At the outset, the paper presents a theoretical model to show how that liberal tax laws have always been attractive for shifting profits. In this background, the paper discusses the outsourced holding company model of tax avoidance used by digital business platforms like Flipkart with a special focus on India and hence decoding the tax design that can be operationalized by the fiscal authority to ensure increased tax revenues from digital value creation under such a case.

30.1 Introduction

Nowadays, names like Flipkart, Amazon, eBay, Snapdeal, Jabong etc. are common in every household. The motivation for choosing economics of multi sided platform as an area of research comes from the rapid growth of the e-commerce sector not

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only in India but across the globe at a frenzied pace, currently estimated at $22.049 trillion across the globe and is predicted to jump to something around $38 billion in the next 5 years (eMarketer Report, 2016). It is an important part of the service sector which is the major contributor to Gross Domestic Product of the major economies. In the recent times taxation of the service sector has become an important issue, especially after the financial crisis of 2008 and the global recession in 2010, the governments across countries are facing a severe constraint in terms of financing their expenditure. Within the service sector, platforms stand out as glaring example of segments which are inadequately taxed: globally very little tax revenue is collected from the online marketplace.

Different countries have different regulations regarding taxation of platforms. According to Tremblay (2016), selling any item through the online marketplace in the United States is untaxed while in the European Union it is taxed to some extent. A recent move to tax online transactions had been proposed for introducing "Google Tax" which is applied on download of songs, movies and apps. It was put forward in Italy as a draft in 2013 but was dropped in 2014 until further progress is made at the international level. A French Expert mission on digital economy (also known as the Collin-Colin Report) proposed a framework for "Google Tax" which was finally dropped on account of severe criticism by the European Commission. At present, according to Bauer (2018), on the part of the governance related issues of the EU, digital companies are being made to pay "their fair share of tax". It is based on the belief that these large corporations in the digital space are not doing it. In this regard, the European Commission is now considering "revenue taxes", i.e. "a levy on revenues generated from the provision of digital services or advertising activity . . .. . . held between in-country customers where a non-resident entity has a significant economic presence." At the end of 2014, the United Kingdom government has announced a "Google Tax"—the Diverted Profit Tax which was launched in 2015 (Bacache et al., 2015). In the developing countries China has introduced an import tax of ad valorem nature on cross-border e-commerce retail imports. In India, platform transactions are being taxed very recently under the scheme called "Google Tax". Consequently, the service sector companies pay very little in tax (See Table 30.1 for details). For example, Google's revenue reached about US$ 74.5 billion in 2016 and yet Google is known to be subject to low effective rates of taxation and even accused of deferring taxes on revenues over US$ 24 billion only in USA (Bourreau, Caillaud, & De Nijs, 2016). On the other hand, services rendered by digital platforms from the buyer side like, delivery charges, handling charges, etc. are not taxed in any country. In this backdrop, the paper discusses the outsourced holding company model of tax avoidance used by digital business platforms like Flipkart with a special focus on India and hence decoding the tax design that can be operationalized by the fiscal authority to ensure increased tax revenues from digital value creation under such a case. In fact, with this advent of technology, it is becoming increasingly difficult to specify what in particular makes a company digital, forget about drawing a line between comparatively more digital, less digital or, in fact, non-digital business models. As Bauer (2018) in his report puts it,

Table 30.1 Digital taxes for selected countries at a glance

Specific country	Tax type	Tax rate (%)	Tax base	Date of enforcement
Italy	Web tax	3	Revenues from taxable digital services.	As on the first of January, 2019.
Austrian (at the proposal stage)	Extension of the advertising levy concept	5	Advertising fee (exclusive of VAT).	Yet to be enforced.
Russia	Google Tax	15.2	Taxable revenue under, • B2C transactions • B2B transactions	For B2C: Since January 1, 2017. For B2B: Since January 1, 2019.
United Kingdom	Diverted Profits Tax	25	The taxable profit avoided in the United Kingdom on account of avoidance of a permanent establishment, is, hence, based on estimates by the UK Tax Authorities.	Since May 2015
India	Equalization Levy	6	The charges for online advertisement in companies not based in India.	Effective since June 1, 2016
Australia	Diverted Profits Tax (similar to UK's case)	40	The amount of taxable profit is determined by Australian Tax Authorities "assessment processes".	Enacted since July 1, 2017 (yet to come into effect)

Source: Compiled by the author

> Moreover, it remained open what exactly falls within the scope of a tax on digital revenues. Indeed, the OECD's digital economy group, who looked at this same issue for more than 2 years, concluded that it was in fact impossible to put a fence around the "digital economy"

Given the varied market structures these platforms operate in, the author presents some motivating examples and hence talks through decoding the tax avoidance notion that exists through the outsourced holding company model. The organization of the paper is as follows. A select literature on issues relating to two sided platforms has been reviewed in Sect. 30.2. Section 30.3 presents the case based business model and discusses the results thereof. The section following concludes.

30.2 Review of Select Literature

The analysis of two sided platforms in the literature is mostly industry specific. The payment card industry, in particular, has been the subject matter in Rochet and Tirole (2004), Schmalensee (2002), Rochet and Tirole (2008), McAndrews and Wang

(2007), among others. Caillaud and Jullien (2001), Ellison, Fudenberg, and Möbius (2004), Jullien (2005) and Bakos and Katsamakas (2008) makes an evaluation of internet intermediary platforms. In the present context, their analysis can be thought of as best suited to website based platforms like Flipkart, Snapdeal, Amazon, eBay, OLX, Magicbricks, etc. Moving on to the media and telecommunications sector, studies by Ferrando, Gabszewicz, Laussel, and Sonnac (2004) and Jeon, Laffont, and Tirole (2004) have their contributions based in this sector while the study by Church, Gandal, and Krause (2008) deal mostly with software platforms in the computer market. Schmalensee and Evans (2007) and Ryasman (2009) deliberated on a strategy for platforms, namely, how the platforms should set their prices for consumers on both the buyers' and the sellers' side in the context of newspaper, payment cards and computer operating system industries. Moving from the sector specific studies to the general studies on pricing theory of competing two sided platforms, the papers include Rochet and Tirole (2003, 2006), Armstrong (2006), Caillaud and Jullien (2003), Hagiu (2007, 2009) and Weyl (2010).

Mostly, there has been theoretical works done so far with the pioneering work by Rochet and Tirole (2003). This paper, although, draws its motivation from the study of credit card market, introduces a general theoretical model of monopoly platform and then moves into the paradigm of platform competition. The results point out how the price is allocated between the two sides determining the end-user surplus for both profit-maximizing and non-profit based platforms. There have been discussions on how the platform should design the charges to be levied on both the buyer and the seller sides with motivating examples. The theoretical set-up has been modeled in such a way that the decision of joining the platform in turn is contingent on the size of the membership fee charged. Clearly, membership fees also must be an integral part of the pricing structure of a platform. With the evolution of game theoretic models in the IO literature, questions were being raised regarding the simultaneous move game modeled in Rochet and Tirole (2003). It was Caillaud and Jullien (2003) coming up with the celebrated "Chicken-and-Egg-Problem" where neither the buyer side nor the seller side will join the platform until and unless the other side under consideration is suitably large. Then emerged the issue of who should move first, the buyer or the seller. However, Caillaud and Jullien (2003) did not offer a clarification on how to resolve this "Chicken-and-Egg-Problem". In this context, a model proposed by Hagiu (2006) talks about sellers first deciding on joining the platform followed by the buyers. The buyers will choose that platform amongst the competing platforms which not only have more supporting sellers but also maximize the buyers' payoff from joining the platform after taking into account the platforms' charges. The question remained as to why the sellers should move first. The author believes that frenzied pace of revolution in information technology drives away the asymmetry of information argument regarding one side observing the other and joining. For this reason, asymmetric information argument is questionable and simultaneous move in joining the platform is very reasonable. Works on the price structure of the platforms (Armstrong, 2006) and introducing product variety (Hagiu, 2009) were the other major contributions in this decade.

Moving to the empirical literature, Goolsbee (2000a) places electronic commerce in the context of fiscal policy for the US economy. It reports findings of a survey which shows that in states where sale tax is higher and buying online is comparatively cheaper, individuals always prefer online transactions controlling for individual characteristics like age, income, education, marital status, minority status, etc. On a similar note, Brynjolfsson and Smith (2000) make use of primary data from individuals' behaviour in online shopping of books and find that individuals strongly favour book sellers in the state with lower tax rate. In another paper, Goolsbee (2000b) argues that allowing the states to apply sales taxes on e-commerce transactions could significantly delay the development of small-sized markets and generate loss twice more than the traditional deadweight loss. This happens because taxing a new technology that has fixed costs associated with adoption can lead to a delay in adoption and a subsequent loss of consumer and producer surplus as compared to taxing a conventional good. Goolsbee (2001) carries out a study on the purchase decision of buying a computer of 20,000 Americans using two alternatives: either online or through a retail store. The study uses data from a survey source *Technographics 99* carried out by a marketing research company named Forrester Research. It comes to a conclusion that decision to buy the computer online depends not only on the price of the computers online but on the price of the computers in retail stores and varies even with the type of customer (US metro area customers and US non-metro area customers) and brands of computer (like Compaq, IBM, Acer, HP, Dell, Toshiba, etc.). Evans (2003) in the American context discusses two specific case studies relating to Diners Club and American Express cards in the payment card industry and Palm Operating System in the software industry. But empirical research in harmony with the existing theoretical literature is still lacking.

The taxation literature on multi sided platforms has developed in the recent years starting with the works of Kind, Koethenbuerger, and Schjelderup (2008, 2009, 2010) on the impact of ad valorem and unit taxes on both the viewer and the advertiser for competing advertising mediums. In their 2010 paper, they show that the imposition of a higher ad valorem tax on the buyers' side does not necessarily lead to a hike in the price charged by the platforms from the buyer side and quite interestingly, Belleflamme and Toulemonde (2016) obtains the same result using unit tax in the context of accommodation platforms in USA like Airbnb. Over and above this, Belleflamme and Toulemonde (2016) comes up with a novel conclusion in the context of competition between two platforms. Their results show that imposing a specific tax on one of the competing platforms may end up increasing the profit of the taxed platform (which they have called 'lucky break') or reducing it twice (called 'double jeopardy'). Similar arguments have come up from Bourreau et al. (2016) in the European Union context of advertising in these digital platforms. The essence of this paper not really lies in the discussion of such theoretical aspects but rather the operational and feasibility part of it.

In the platform literature, the avoidance of taxes issue till now is not developed. The main contribution of the paper lies in the comparison of different business models existing at present, and how the government should take due care in the process of framing policies on tax avoidance.

30.3 The Business Model with Its Tax Avoidance Scheme

30.3.1 The Theoretical Motivation

The idea of developing this theoretical model is to validate the reason as to why tax havens or countries having liberal tax norms offering heavy tax exemptions call for greater level of investments. The model developed in this section has been heavily drawn from a recent work by the author (Mukherjee, 2018) which has been slightly modified to take into account the issue of tax competition between firms. Suppose, there are two countries, a and b, where the author considers the multinational firms' inverse market demand curves given by,

$$p_a = \gamma_a - \beta q_a \tag{30.1}$$

$$p_b = \gamma_b - \beta q_b \tag{30.2}$$

Given, $\gamma_a \geq \gamma_b$

Each of the platforms are deciding where to locate their basic holding company firm.

There are n multinational firms (consider digital giants like Flipkart, Amazon) and each of these n homogeneous firms have a branch in each of the country. These firms compete in a Cournot set-up in each market to decide where to register their holding company firm through which the digital platform operates. The intention of the firms is to move their profits where they are subject to lesser tax rates and route it through this holding-subsidiary company set-up.[1] The unit production costs, the cost to ship goods across countries have been normalized to zero. More precisely, letting π_i^j be the profit effectively generated by firm j = 1, 2, 3,. . . . . ., n in country i = a, b. To escape the tax liability, the actual profit generated is not reported. This means that the declared profit across the two countries should add up to total profit of that particular firm in the two countries. Following the work of Hindriks, Perlata, and Weber (2014), the constraint becomes $\pi_a{}^j + \pi_b{}^j = \tilde{\pi}_a{}^j + \tilde{\pi}_b{}^j$ for the j^{th} firm across two countries, a and b. $\tilde{\pi}_i{}^j$ denotes the amount of profit reported by the j^{th} firm in the i^{th} country.

The firms plan to conceal their true profits based on what taxes the governments in different countries charge. Concealing true profits attract a fine and if the firm gets

[1]It should be clearly pointed out that here we are not looking at the micro-foundations of how platform prices get determined through network effects as discussed in the literature but rather we are looking at the holding companies behind these digital platforms who try to locate themselves based on tax competition across countries.

caught the entire profit gets confiscated and the firm gets zero. The probability of non-detection is given by d and it remains same across countries for sake of simplicity. Thus, the author introduces concealment cost in this manner as: $2\left(\pi_i{}^j - \widetilde{\pi}_i{}^j\right)^2$ for the j^{th} firm in the i^{th} country. Doing the concealment of profit counts for both the countries i.e. doing for one country implies that it is done for the other country also as the structure is the same. The government in country i sets a source-based tax rate, t_i, on the profit reported within its tax-jurisdiction by the n multinational firms, and its tax revenue is given by:

$$R_i = t_i\left(\widetilde{\pi}^1{}_i + \widetilde{\pi}^2{}_i + \widetilde{\pi}^3{}_i + \ldots\ldots \widetilde{\pi}^n{}_i\right), i = a \text{ and } b \tag{30.3}$$

The objective of the j^{th} firm is to maximize its profit across the two countries given the tax rates set by the governments of the two countries.

The objective of the j^{th} firm,

$$\max\ d(1 - t_a)\widetilde{\pi}^j{}_a + d(1 - t_b)\widetilde{\pi}^j{}_b - 2\left(\pi_a{}^j - \widetilde{\pi}_a{}^j\right)^2$$

$$\text{w.r.t}\left(q^j{}_a, q^j{}_b, \widetilde{\pi}_a{}^j\right)$$

$$\text{s.t}\quad \widetilde{\pi}_a{}^j + \widetilde{\pi}_b{}^j = p_a\left(q^1{}_a + q^2{}_a \ldots\ldots + q^n{}_a\right)q^j{}_a + p_b\left(q^1{}_b + q^2{}_b \ldots\ldots + q^n{}_b\right)q^j{}_b$$

In this case, the number of variables reduces to three as $\widetilde{\pi}_b{}^j$ can be written in terms of the other three variables.

Rewriting the maximization problem after combining the constraint,

$$\begin{aligned} &d(1 - t_a)\widetilde{\pi}^j{}_a + d(1 - t_b) \\ &\quad \times \left[\left(\gamma_a - \beta\left(q^1{}_a + q^2{}_a \ldots\ldots + q^n{}_a\right)\right)q^j{}_a + \left(\gamma_b - \beta\left(q^1{}_b + q^2{}_b \ldots\ldots + q^n{}_b\right)\right)q^j{}_b - \widetilde{\pi}_a{}^j\right] \\ &\quad - 2\left(\pi_a{}^j - \widetilde{\pi}_a{}^j\right)^2 \end{aligned}$$

From the first-order conditions:

$$\begin{aligned} &\text{(i)}\quad - dt_a + dt_b + 4\left(\left\{\gamma_a - \beta\left[q^1{}_a + q^2{}_a \ldots\ldots + q^n{}_a\right]\right\}q^j{}_a - \widetilde{\pi}_a{}^j\right) \\ &\quad = 0 \text{ or, } - d\left(\frac{t_a - t_b}{4}\right) + \left\{\gamma_a - \beta\left[q^1{}_a + q^2{}_a \ldots\ldots + q^n{}_a\right]\right\}q^j{}_a = \widetilde{\pi}_a{}^j \end{aligned} \tag{30.4}$$

$$\begin{aligned}\text{(ii)}\quad & d(1-t_b)\left[\gamma_a-\beta\left(q^1{}_a+q^2{}_a\ldots\ldots+q^n{}_a\right)-2\beta q^j{}_a\right]\\ & -4\left(\left\{\gamma_a-\beta\left[q^1{}_a+q^2{}_a\ldots\ldots+q^n{}_a\right]\right\}q^j{}_a-\widetilde{\pi}_a{}^j\right)\\ & \times\left[\gamma_a-2\beta q^j{}_a-\beta\left(q^1{}_a+q^2{}_a\ldots\ldots+q^n{}_a\right)\right]\\ & =0\end{aligned} \tag{30.5}$$

Using (30.4) and (30.5) we get,

$$\begin{aligned} & d(1-t_b)\left[\gamma_a-\beta\left(q^1{}_a+q^2{}_a\ldots\ldots+q^n{}_a\right)-2\beta q^j{}_a\right]-d(t_a-t_b)\\ & \quad\times\left[\gamma_a-2\beta q^j{}_a-\beta\left(q^1{}_a+q^2{}_a\ldots\ldots+q^n{}_a\right)\right]\end{aligned}$$

or, $d(1-t_b-t_a+t_b)\left[\gamma_a-\beta\left(q^1{}_a+q^2{}_a\ldots\ldots+q^n{}_a\right)-2\beta q^j{}_a\right]=0, t_a\neq 1, d\ / =0$

$$\text{or,}\quad q^j{}_a=\frac{\gamma_a-\beta(q^1{}_a+q^2{}_a\ldots\ldots+q^n{}_a)}{2\beta} \tag{30.6}$$

Similarly, carrying out the first order condition in terms of $q^j{}_b$, we have,

$$q^j{}_b=\frac{\gamma_b-\beta(q^1{}_b+q^2{}_b\ldots\ldots+q^n{}_b)}{2\beta} \tag{30.7}$$

Analogously carrying out the maximization exercise for the n firms leads us to n such conditions for the n firms, i.e. j = 1, 2, 3 … n. It should be noted that in Eqs. (30.6) and (30.7), the term within brackets include (n−1) terms actually as j^{th} firm is excluded.

At the Nash Equilibrium, $q^1{}_a=q^2{}_a=q^j{}_a\ldots\ldots=q^n{}_a=q^*{}_a$ and

$$q^1{}_b=q^2{}_b=q^j{}_b\ldots\ldots=q^n{}_b=q^*{}_b.$$

So solving the values from Eqs. (30.6) and (30.7),

$$q^*{}_a=\frac{\gamma_a}{\beta(n+1)},\ q^*{}_b=\frac{\gamma_b}{\beta(n+1)} \tag{30.8a}$$

Putting back the values in Eqs. (30.1) and (30.2), we get,

$$p_a=\frac{\gamma_a}{(n+1)},\ p_b=\frac{\gamma_b}{(n+1)} \tag{30.8b}$$

By putting back the equilibrium values in Eq. (30.4), the profits reported by j^{th} firm in country a and b can be derived as follows,

$$-d\left(\frac{t_a - t_b}{4}\right) + \left\{\gamma_a - \beta\left[\frac{n\gamma_a}{(n+1)\beta}\right]\right\}\frac{\gamma_a}{\beta(n+1)} = \widetilde{\pi}_a{}^j \tag{30.9}$$

$$-d\left(\frac{t_b - t_a}{4}\right) + \left\{\gamma_b - \beta\left[\frac{n\gamma_b}{(n+1)\beta}\right]\right\}\frac{\gamma_b}{\beta(n+1)} = \widetilde{\pi}_b{}^j \tag{30.10}$$

The total profit disclosed in country a is as follows, $\widetilde{\pi}_a = n\widetilde{\pi}_a{}^j$, $j = 1, 2, 3, \ldots n$

$$\Rightarrow \widetilde{\pi}_a = n\left[-d\left(\frac{t_a - t_b}{4}\right) + \left\{\gamma_a - \beta\left[\frac{n\gamma_a}{(n+1)\beta}\right]\right\}\frac{\gamma_a}{\beta(n+1)}\right]$$

Analogously one can write it for the second country. Firstly, we move on to the first case of tax competition among the countries. The objective of the government is to choose the taxes in such a way that global corporations get attracted to locate their businesses in the country having a relatively lower tax rate. The entire thing happens in a setting of detection of concealment of true profits. Starting off with tax competition, the government in country a collects tax revenue given by,

$$R_a = t_a\left(\widetilde{\pi}^1{}_a + \widetilde{\pi}^2{}_a + \widetilde{\pi}^3{}_a + \ldots\ldots \widetilde{\pi}^n{}_a\right) \tag{30.11}$$

and similarly,

$$R_b = t_b\left(\widetilde{\pi}^1{}_b + \widetilde{\pi}^2{}_b + \widetilde{\pi}^3{}_b + \ldots\ldots \widetilde{\pi}^n{}_b\right) \tag{30.12}$$

The first order conditions from the revenue maximization of the government yields,

$$\frac{\partial R_a}{\partial t_a} = 0 \Rightarrow n\left[\left\{\gamma_a - \beta\left[\frac{n\gamma_a}{(n+1)\beta}\right]\right\}\frac{\gamma_a}{\beta(n+1)}\right] - nd\left[\frac{t_a}{2} - \frac{t_b}{4}\right] = 0 \tag{30.13}$$

$$\frac{\partial R_b}{\partial t_b} = 0 \Rightarrow n\left[\left\{\gamma_b - \beta\left[\frac{n\gamma_b}{(n+1)\beta}\right]\right\}\frac{\gamma_b}{\beta(n+1)}\right] - nd\left[\frac{t_b}{2} - \frac{t_a}{4}\right] = 0 \tag{30.14}$$

For comparison of the tax rates across countries, γ_b and γ_a has been normalized as,

$$\gamma_a = \frac{(n+1)}{n}\sqrt{\beta(1+\varepsilon)}, \gamma_b = \frac{(n+1)}{n}\sqrt{\beta(1-\varepsilon)} \tag{30.15}$$

Invoking Eq. (30.15)[2] in Eqs. (30.13) and (30.14),

[2] ε denotes the heterogeneity between the two countries in terms of fiscal revenue, market size, etc., i.e. $0 \leq \varepsilon \leq 1$.

$$\left[\frac{t_a}{2} - \frac{t_b}{4}\right] nd = \frac{1+\varepsilon}{n} \tag{30.16}$$

$$\left[\frac{t_b}{2} - \frac{t_a}{4}\right] nd = \frac{1-\varepsilon}{n} \tag{30.17}$$

Solving Eqs. (30.16) and (30.17) simultaneously,

$$t_a = \frac{4(3+\varepsilon)}{3n^2 d};\ t_b = \frac{4(3-\varepsilon)}{3n^2 d} \tag{30.18}$$

Both t_a and t_b are <1 as $n > 2\sqrt{\frac{1}{d}\left(1+\frac{\varepsilon}{3}\right)}$.

30.3.2 Results

1. At the Nash equilibrium, there is under-taxation as both countries want to outcompete the other.
2. If the probability of non-detection falls or there are heavy tax exemptions, liberal tax compliance policies i.e. actually probability of detection rises then profit shifting becomes more costly. This is indicative of the fact that profit gets declared in that country where the effective tax rate is less. □

Having seen that how liberal tax laws attract profits, now, we move on to the case study of the outsourced holding company business model that is functional in reality and discuss in this context, how the optimal tax design should be like. This model gives us an idea as to where the holding company incorporation of the digital platform should take place. Unambiguously, the solution is a low tax country.

30.3.3 The Outsourced Holding Company Model: Case of Flipkart

To elaborately explain the Flipkart style of functioning and the way it operates, the discussion follows. Flipkart's principal way of functioning is to source out the goods from manufacturers and then sell off those goods to third party sellers who in turn use Flipkart's platform to sell it to the final buyers. So, Flipkart makes a commission on every sale that takes place on its technology platform using its logistics services. With a naked eye what appears to be a pure marketplace, is actually not. This brings us to the operational structure of Flipkart and the mechanism of tax avoidance legally.

Flipkart has set-up a intricate maze of nine entities (refer to Fig. 30.2) through more than six rounds of investments, around fifteen stakeholders and several

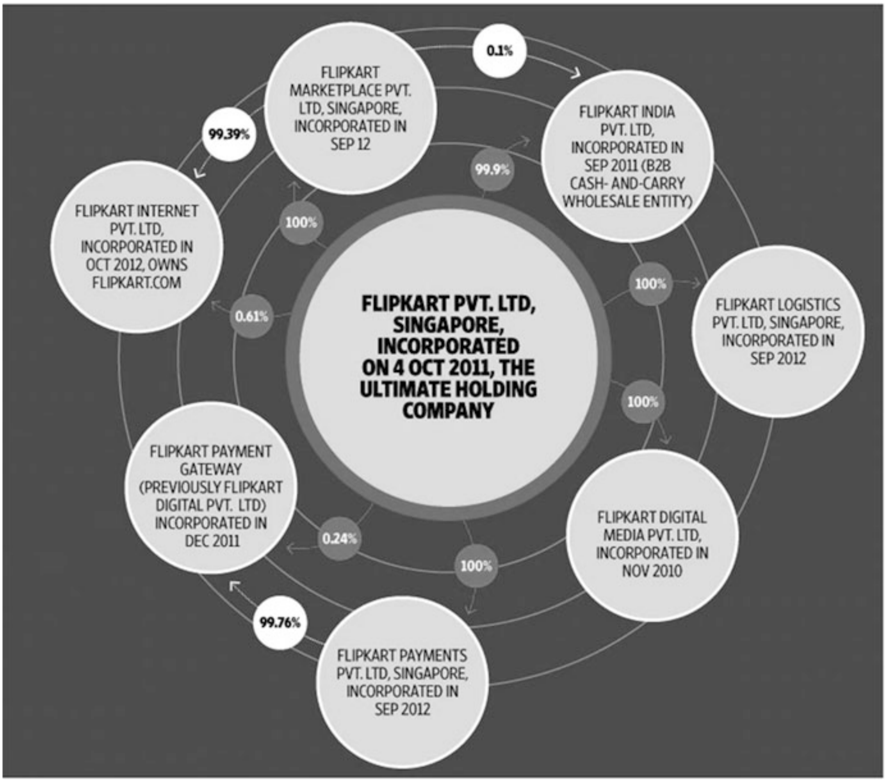

Fig. 30.1 Flipkart's business model. Source: Adapted from Verma and Dalal (2014)

acquisitions making any tax consultant proud. Coming to the arrangement, all of Flipkart's corporate entities is a part of the main holding entity, named, Flipkart Pvt. Ltd. (FPL), registered in Singapore on October 2011. Under this holding company, there are three 100% subsidiaries of FPL, namely, first, Flipkart Marketplace Pvt. Ltd. (FMPL; also called WS Retail, this being Flipkart's in-house vendor), second, Flipkart Logistics Pvt. Ltd. (FLPL; also called Ekart logistics), third, Flipkart Payments Pvt. Ltd. (FPPL) and fourth, Flipkart Digital Media Pvt. Ltd. (FDMPL). These four companies have their stake in five Indian corporate entities, i.e. the cash-and-carry segment, Flipkart India Pvt. Ltd.; the platform Flipkart.com under Flipkart Internet Pvt. Ltd.; a dormant Digital Media Pvt. Ltd.; Digital Management Services Pvt. Ltd. running Letsbuy.com; and the payment gateway: Flipkart Payment Gateway Services Pvt. Ltd., which ran Payzippy. But some of these Indian entities are again direct subsidiaries of FPL by way of holding a very negligible share (see Fig. 30.2). However, for the holding company in Singapore, Tiger Global, Naspers,

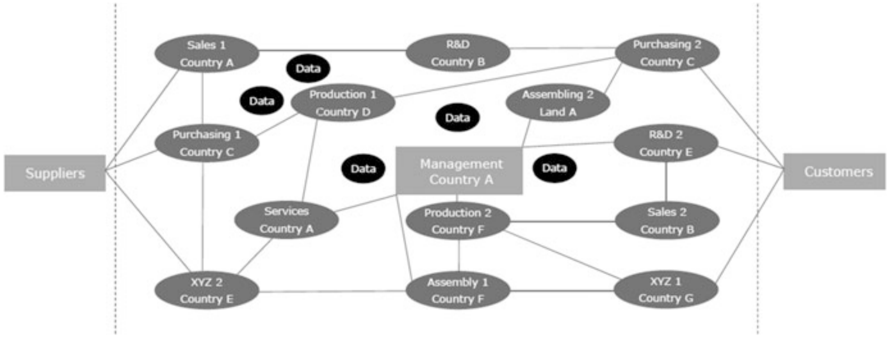

Fig. 30.2 The complex web of supply chains

Accel Partners, the Bansals[3] (Sachin Bansal resigned in 2018) and Iconiq Capital largely control the ownership of FPL, Singapore[4] post the Walmart Acquisition.

Before moving to the tax implications of the Walmart acquisition, one needs to carefully understand the basic *modus operandi* with which Flipkart functioned for almost a decade. Back in 2007–2008, Government of India did not allow 100% FDI in the multi-brand retail sector. As a remedy for not only being able to raise foreign investments but also to enjoy Singapore's business-responsive taxation policies, allowance of extreme tax exemptions on foreign-source incomes, etc., the founders of Flipkart moved their "backend operations"[5] to Singapore making Flipkart India, Ekart and WS retail fully owned subsidiaries of FPL so that the income can get routed through the holding company registered in Singapore.

For a complex value chain (like the one discussed in Fig. 30.2) of Sales, Purchasing and R & D happening both in an inter-country and intra-country set-up, it becomes extremely difficult for the tax compliance authorities to assess the amount of value creation to be taxed.

The next part of the story is to simulate the optimal tax design based on Eq. (30.18) above. For a model of tax competition among countries, the liberalness in the tax laws and tax compliance is what matters the most depending on which multinational companies shift their profits through some complex transfer mechanism as discussed. For $\varepsilon = 0.1$ (i.e. significant differences in terms of heterogeneity in terms of market size, tax structure and normalizing the mass of platforms in the economy to be 10[6] (the number is based on the number of major online platforms operating in India), the simulation mechanism yields the following tax rate values (see Fig. 30.3) corresponding to the different values of the tax compliance parameter, d.

[3]"Flipkart co-founder likely to quit after Walmart takeover". *The Times of India*. 4 May 2018.

[4]Now, in May 2018, US retail chain giant, Walmart, acquired a majority stake (of around 77%) in Flipkart for US$ 15 billion.

[5]Behind the scene operations of a business where there is no direct link with the customer.

[6]https://www.goodworklabs.com/top-five-e-commerce-websites-in-india/

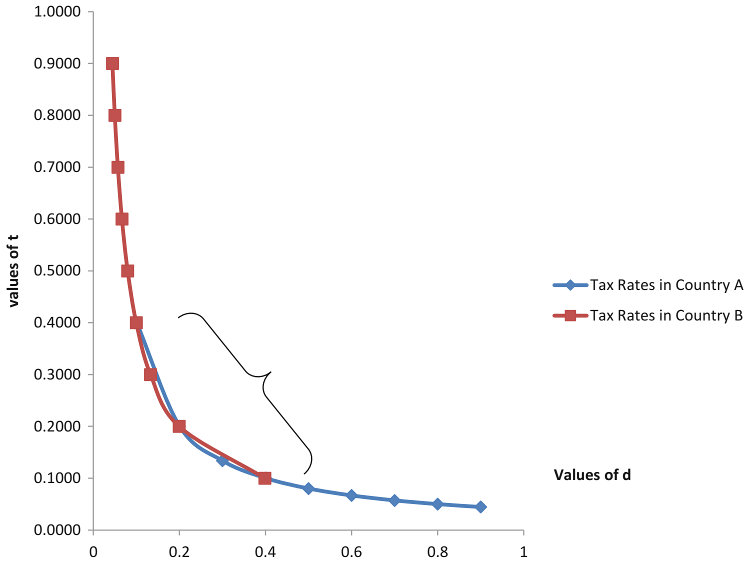

Fig. 30.3 The optimal tax design based on the model. Source: Author's Compilation

In the figure given below, there are two tax rates as marked, one for Country A and the other for Country B. For different values of the tax compliance parameter, d, the two countries kind of settle on a particular tax rate, one being comparatively less than the other. For digital platforms like Flipkart who use this outsourced holding company model, try to fit in both the countries depending on the stringency of tax compliance. For the Indian case, where there is an equalization levy of 6% magnitude and relatively stringent tax compliance norms, i.e. relatively lower values of d (see Fig. 30.3), tax competition is existent but of a very low magnitude. The more stringent are the tax compliance rules, greater will be the complexity of the model created to avoid taxes (see Fig. 30.3 for the regions which possibly can have the existence of complex DVCs following the {d, t} combinations that are feasible). In other words, imposing even stricter tax compliance norms would result in greater tradeoff with the relatively low tax country and at some extreme point will result in the shifting of the entire profit to the low tax country.

30.3.3.1 The Implications for India

Taxing such business model is a challenge for tax compliance authorities. With so many of foreign entities involved, the Walmart-Flipkart deal has set the ball rolling with a fusillade of questions. The deal that is being struck is that shareholders in the Singapore registered FPL would transfer their shares to Walmart. Since, those shareholders having their claim in the holding company are somehow registered in some tax haven, like, Tiger Global is a Mauritius based corporate. In such a case, the

Indian tax authorities can't claim tax on these overseas entities under the India-Mauritius treaty. This brings us to a simple question, that, how did Government of India tax the capital gains made from the sale of shares of Flipkart by overseas non-resident investors?

Keeping in mind the structure in Fig. 30.2, the Tax pundits believe that it is a challenge to tax such a complicated Digitally "enhanced" Value Chain (DVC). The issue, however is, no matter whatever loophole these digital firms try to take advantage of, transfer of shares under such circumstances is considered as an indirect sale of shares of Flipkart India and, for that reason, would bring in effect the charging of capital gains tax in India for such NRI investors, minus the exemptions/benefits from tax treaty, if any. Complexities are many but solutions are less.

There is a different school of thought who says that since there is no change in the pattern of Flipkart Singapore's holding in the Indian subsidiary, the India-Mauritius and Indo-USA treaty becomes applicable and hence capital gains arising out of such a deal get settled within the domestic law of the individual state concerned. The problem lies here, with the Indo-USA Treaty leaves it to Indian jurisdiction, Tiger Global's sale as a part of the Mauritius Treaty presents the ambiguity. The mixture of treaties at their different level of exemptions makes it more complicated. Strangely enough, Walmart has paid only Rs 7439 crore as tax on payment for acquiring shares of ten major shareholders but in reality, there are 44 shareholders of Flipkart who exited the Indian e-commerce company in the backdrop of this acquisition deal. Therefore, their rendezvous with the Indian tax department continues. The Income Tax Department, has started reviewing 'Section 9 (1) of the IT Act', that particularly deals with "indirect transfer provisions" to reconcile the benefits available for foreign investors selling their respective stakes to Walmart arising under such bilateral tax treaties, like the ones with Singapore and Mauritius. This model presents one form of ambiguity on account of complex digital value chains embodied by Flipkart.

30.4 Conclusion

As is now well understood by economists, trying to rope in digital platforms into the tax net requires policy designers to give special attention to the platforms' features when dealing about them. The paper argues that the mechanism that is followed for transfer pricing needs to take into account the idiosyncrasies of digital platforms so that in practice the methodology gets aligned to the quantum of value creation happening on the platform.

Here comes the question of attribution. In other words, for OECD, the onus lies with the 'BEPS stakeholders' to clearly spell out how the OECD wants the taxable income (with regards to the profits generated on different sides of a multi-faceted platform) to be charged. This paper gives a synoptic review of the complex DVC's operating under the outsourced holding company style of models and the associated tax designs (or loopholes) that exists. Theoretically, it has been validated that platforms would register themselves either in one specific place or follows a convex combination of locational arrangements depending on the stringency of the tax compliance structure.

In the Indian context, the 6% Equalization Levy on digital transactions since the year 2016, as a part of Action Plan 1 of the BEPS and launching of GAAR with effect from the 1st of April, 2017, has made significant contributions in spreading out the domain of levy of Service Tax clubbed under the aegis of GST. As India is gearing up to make its tax laws more dynamic to stand at par with the international standards, this 6% levy is until now a hit—with approximate tax revenue generated through levy by non-resident companies like Google, Facebook, Twitter and other digital service networks, stands between Rs 560 and 590 crore, during the financial year 2017–2018.[7]

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