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Table of Contents  
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**Emerging Technologies for Innovation Management in the Software Industry**  
Varun Gupta (Universidad de Alcalá, Madrid, Spain) and Chetna Gupta (Jaypee Institute of Information Technology, Noida, India)  
Release Date: May, 2022 | Copyright: © 2022 | Pages: 282  
DOI: 10.4018/978-1-7998-9059-1  
ISBN13: 9781799890591 | ISBN10: 1799890597 | EISBN13: 9781799890614 | ISBN13 Softcover: 9781799890607

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# Table of Contents

|                                                                                                                                                         |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| <b>Preface</b> .....                                                                                                                                    | xiv |
| <b>Acknowledgment</b> .....                                                                                                                             | xxv |
| <b>Chapter 1</b>                                                                                                                                        |     |
| Development Frameworks for Software Startups: A Literature Review .....                                                                                 | 1   |
| <i>Narendranath Shanbhag, La Trobe University, Australia</i>                                                                                            |     |
| <i>Eric Pardede, La Trobe University, Australia</i>                                                                                                     |     |
| <b>Chapter 2</b>                                                                                                                                        |     |
| Digitally-Enabled Innovation Processes: The Emergence of a New Management Logic .....                                                                   | 44  |
| <i>Haneen Abdallah Allataifeh, Univeristy of Malaya, Malaysia</i>                                                                                       |     |
| <i>Sedigheh Moghavvemi, University of Malaya, Malaysia</i>                                                                                              |     |
| <b>Chapter 3</b>                                                                                                                                        |     |
| Emerging Technologies for Innovation and Productivity Management in the Automotive Industry:<br>Impact of Digital Transformation on Communication ..... | 60  |
| <i>Anthony D. Bolton, University of South Africa, South Africa</i>                                                                                      |     |
| <i>Leila Goosen, University of South Africa, South Africa</i>                                                                                           |     |
| <i>Elmarie Kritzinger, University of South Africa, South Africa</i>                                                                                     |     |
| <b>Chapter 4</b>                                                                                                                                        |     |
| An Integrative Model of Hardware Product Development in Startup Contexts: A Qualitative Study .                                                         | 86  |
| <i>Khalid Khan, Karachi Institute of Economics and Technology, Pakistan</i>                                                                             |     |
| <i>Faiza Khan, Karachi Institute of Economics and Technology, Pakistan</i>                                                                              |     |
| <i>Trung Nguyen Quang, Thuongmai University, Vietnam</i>                                                                                                |     |
| <i>Anh Nguyen Duc, University of South-Eastern Norway, Norway</i>                                                                                       |     |
| <b>Chapter 5</b>                                                                                                                                        |     |
| Value Proposition Innovation in Startups: Value Proposition Identification and Prioritization .....                                                     | 109 |
| <i>Varun Gupta, University of Alcala, Spain</i>                                                                                                         |     |
| <i>Chetna Gupta, Jaypee Institute of Information Technology, India</i>                                                                                  |     |
| <i>Luis García Piedrabuena, University of Alcala, Spain</i>                                                                                             |     |

## **Chapter 6**

Ambidexterity, Knowledge Management, and Innovation in Technology Development Zones: The Case of Turkey ..... 115

*Şükran Sirkintioğlu Yildirim, Kastamonu University, Turkey*

*Özlem Atay, Ankara University, Turkey*

## **Chapter 7**

Emerging Technologies Supporting Knowledge Management for Innovation Management ..... 134

*Kağan Okatan, Istanbul Beykent University, Turkey*

## **Chapter 8**

Empirical Insights Into Software Startups ..... 151

*Varun Gupta, University of Alcala, Spain*

*Zoe Hoy, University of Portsmouth, UK*

*Chetna Gupta, Jaypee Institute of Information Technology, India*

## **Chapter 9**

Use of Framework Synthesis to Identify the Factors Considered for Five Popular Prioritisation Approaches..... 157

*Zoe Hoy, University of Portsmouth, UK*

## **Chapter 10**

Awareness Without Actions: A Qualitative Study on Risk Management in Nordic Software Startups ..... 168

*Quang-Trung Nguyen, ThuongMai University, Vietnam*

*Thananya Phromwongsa, University of Southern Denmark, Denmark*

*Sharanka Shanmugalingam, University of Southern Denmark, Denmark*

*Victor Steinfeldt Laursen, University of Southern Denmark, Denmark*

*Indira Nurdiani Jabangwe, University of Southern Denmark, Denmark*

*Anh Nguyen-Duc, University of South-Eastern Norway, Norway*

## **Chapter 11**

COVID's Scholarly Literature and Innovation in Startups ..... 182

*Varun Gupta, University of Alcala, Spain*

*Chetna Gupta, Jaypee Institute of Information Technology, India*

*Lawrence Peters, Software Consultants International Limited, USA & Universidad*

*Politecnica de Madrid, Madrid, Spain*

*Leandro Pereira, ISCTE, University Institute of Lisbon, Lisboa, Portugal*

## **Chapter 12**

|                                                                                                        |     |
|--------------------------------------------------------------------------------------------------------|-----|
| IT Technologies in Mechanical Engineering: Impact of IT Technologies on the Engineering Industry ..... | 187 |
|--------------------------------------------------------------------------------------------------------|-----|

*Anastasia Sergeevna Samoylova, Federal State Autonomous Educational Institution of Higher Education, Moscow Polytechnic University, Russia*

*Ekaterina Olegovna Bobrova, Federal State Budgetary Educational Institution of Higher Education Lomonosov, Moscow State University, Russia*

*Valentina Valentinovna Britvina, Federal State Autonomous Educational Institution of Higher Education, Moscow Polytechnic University, Russia*

*Galina Pavlovna Konyukhova, Moscow State University of Technology, Russia*

## **Chapter 13**

|                                                                                   |     |
|-----------------------------------------------------------------------------------|-----|
| Sixteen Limitations for Five Popular Requirements Prioritisation Approaches ..... | 202 |
|-----------------------------------------------------------------------------------|-----|

*Zoe Hoy, University of Portsmouth, UK*

## **Chapter 14**

|                                                                 |     |
|-----------------------------------------------------------------|-----|
| Technology-Based Innovation for Business Model Innovation ..... | 223 |
|-----------------------------------------------------------------|-----|

*S Meenakshi Sundaram, GSSS Institute of Engineering and Technology for Women, India*

*Tejaswini R. Murgod, GSSS Institute of Engineering and Technology for Women, India*

*Sowmya M., GSSS Institute of Engineering and Technology for Women, India*

|                                        |     |
|----------------------------------------|-----|
| <b>Compilation of References</b> ..... | 237 |
|----------------------------------------|-----|

|                                     |     |
|-------------------------------------|-----|
| <b>About the Contributors</b> ..... | 275 |
|-------------------------------------|-----|

|                    |     |
|--------------------|-----|
| <b>Index</b> ..... | 280 |
|--------------------|-----|

# Detailed Table of Contents

|                      |     |
|----------------------|-----|
| <b>Preface</b> ..... | xiv |
|----------------------|-----|

|                             |     |
|-----------------------------|-----|
| <b>Acknowledgment</b> ..... | xxv |
|-----------------------------|-----|

## **Chapter 1**

|                                                                         |   |
|-------------------------------------------------------------------------|---|
| Development Frameworks for Software Startups: A Literature Review ..... | 1 |
|-------------------------------------------------------------------------|---|

*Narendranath Shanbhag, La Trobe University, Australia*

*Eric Pardede, La Trobe University, Australia*

The chapter reported the results of investigation of existing product and business model development frameworks and identified any gaps or scopes for improvement that can benefit aspiring software startups by improving their chances of success in their entrepreneurial ventures. Accordingly, current literature in the space of both product and business model development including overlapping areas are reviewed, and their values along with potential for improvement are highlighted.

## **Chapter 2**

|                                                                                       |    |
|---------------------------------------------------------------------------------------|----|
| Digitally-Enabled Innovation Processes: The Emergence of a New Management Logic ..... | 44 |
|---------------------------------------------------------------------------------------|----|

*Haneen Abdallah Allataifeh, Univeristy of Malaya, Malaysia*

*Sedigheh Moghavvemi, University of Malaya, Malaysia*

This chapter investigated the way digital technologies impact the innovation process and ultimately reshape the way business processes are designed and managed. It also sheds light on the link between digital innovation and BPM and the means by which they complement and reshape one another. The following sections explain the characteristics of digital technology, the impact of digitalization on innovation processes, and the link between digital innovation and BPM.

## **Chapter 3**

Emerging Technologies for Innovation and Productivity Management in the Automotive Industry:

|                                                         |    |
|---------------------------------------------------------|----|
| Impact of Digital Transformation on Communication ..... | 60 |
|---------------------------------------------------------|----|

*Anthony D. Bolton, University of South Africa, South Africa*

*Leila Goosen, University of South Africa, South Africa*

*Elmarie Kritzing, University of South Africa, South Africa*

This chapter introduces an area of research related to the implementation of emerging unified communications and collaboration (UC&C) technologies for productivity and innovation management within the context of large-scale automotive design, manufacturing, and business operations at General

Motors (GM), a leader in the global automotive industry. It further discusses how the chapter bridges the gaps presented through the design of the research developed with the purpose of evaluating the impact of said emerging technologies. In terms of mentioning what problems existed, prior to the research undertaking reported on in this chapter, General Motors had not implemented unified communications within its manufacturing, design, or business operation functions and had not engaged in the development of an internet of things (IoT)-related digitization strategy.

#### **Chapter 4**

An Integrative Model of Hardware Product Development in Startup Contexts: A Qualitative Study . 86

*Khalid Khan, Karachi Institute of Economics and Technology, Pakistan*

*Faiza Khan, Karachi Institute of Economics and Technology, Pakistan*

*Trung Nguyen Quang, Thuongmai University, Vietnam*

*Anh Nguyen Duc, University of South-Eastern Norway, Norway*

This chapter reported the results of an empirical investigation on five hardware startup companies about hardware startup product development. This chapter reported some common good practices among hardware startups (i.e., process definition, evolutionary development process, and document management). We reveal several factors that are different from software startups, such as low priority of product quality, product pipeline, and unrecognized product platform. This chapter also proposes an integrative process model of hardware product development that shows the connections between human factors in the startups, their speed-prioritized development processes, and the consequence of hindered productivity in the later phases. The model has some implications for hardware startup founders to plan for the trade-off between team, speed, quality, and later productivity.

#### **Chapter 5**

Value Proposition Innovation in Startups: Value Proposition Identification and Prioritization ..... 109

*Varun Gupta, University of Alcala, Spain*

*Chetna Gupta, Jaypee Institute of Information Technology, India*

*Luis García Piedrabuena, University of Alcala, Spain*

In highly dynamic situations, entrepreneurs build value propositions in resource-constrained conditions. The activity is set up as a series of experiments, with each one aimed at validating value proposition-related assumptions with customers. Validation entails interactions between potential customers and the startup team utilizing prototypes, which leads to the confirmation of current assumptions as well as the discovery of new insights that lead to more experiments. The main features of the value proposition identification model are highlighted in this chapter, and a novel value prioritizing approach is proposed.

#### **Chapter 6**

Ambidexterity, Knowledge Management, and Innovation in Technology Development Zones: The Case of Turkey ..... 115

*Şükran Sirkintioğlu Yildirim, Kastamonu University, Turkey*

*Özlem Atay, Ankara University, Turkey*

This chapter searches how knowledge management and innovation activities, which enable an advantageous position for firms over their opponents, influence ambidexterity and business performance. These enable firms to gain an advantage over their competitors, concerning ambidexterity and organizational performance. The population for this study comprises firms, operating in technology development zones in Ankara,

Turkey. According to the sectoral distribution of the enterprises in the technology development zones, the majority operate in the software sector. No sampling methods were used because the census method was adopted. Three hundred sixty high-tech enterprise top managers form the basis of this empirical research. In this study, structural equation modeling was used for testing research model. As a result of the structural equation modeling, it was understood that firms' knowledge management and innovation usage preferences have a positive impact on ambidexterity and organizational performance. This outcome is important for firms to gain a competitive advantage.

## **Chapter 7**

|                                                                                       |     |
|---------------------------------------------------------------------------------------|-----|
| Emerging Technologies Supporting Knowledge Management for Innovation Management ..... | 134 |
| <i>Kağan Okatan, Istanbul Beykent University, Turkey</i>                              |     |

This chapter provided the discussion about innovation management with reference to the software industry. Much attention is drawn to the importance of knowledge management in this chapter. Knowledge management covers four phases: create, structure, share, and apply. Successful management of these phases leads to successful knowledge management outcomes. From the moment it emerged, the internet of things has made a positive difference in providing high-volume and instant data communication, especially between computer systems, which are one of the basic components of knowledge management systems. Artificial intelligence (AI) uses modern technologies to simplify the discovery of knowledge. Thus, knowledge management could be aided by the use of AI.

## **Chapter 8**

|                                                                        |     |
|------------------------------------------------------------------------|-----|
| Empirical Insights Into Software Startups .....                        | 151 |
| <i>Varun Gupta, University of Alcala, Spain</i>                        |     |
| <i>Zoe Hoy, University of Portsmouth, UK</i>                           |     |
| <i>Chetna Gupta, Jaypee Institute of Information Technology, India</i> |     |

Software startups bring innovative products to the market. However, such innovation is at the cost of highly educated guesswork about customer expectations and quick decision making by persons responsible for strategic planning and implementation. It is therefore of interest to understand the challenges and practices faced by startups that aim to release something innovative in selected market segments. Hence, this chapter investigates the challenges faced by entrepreneurs of startups and the practices they follow to become successful. The specific challenges explored include (1) how startups handle software evolution, (2) challenges faced in releasing products to the market, and (3) the state of affairs of software engineering in startups. Results indicate that despite guidance and support in terms of well-known and documented development methods, practitioners find it difficult to implement and apply these in practice. They must quickly evolve their products to sustain in the market, and the market is highly uncertain, which makes the complete process highly probabilistic.

## **Chapter 9**

|                                                                                                               |     |
|---------------------------------------------------------------------------------------------------------------|-----|
| Use of Framework Synthesis to Identify the Factors Considered for Five Popular Prioritisation Approaches..... | 157 |
| <i>Zoe Hoy, University of Portsmouth, UK</i>                                                                  |     |

This chapter identifies the factors considered when prioritising requirements for five popular prioritisation approaches. This research also compares these factors to the agile requirement re-prioritisation process to see how well these popular approaches support the agile process. The five popular requirement

prioritisation approaches are analytic hierarchy process (AHP), quality functional deployment (QFD), planning game, binary search tree, and \$100 allocation. Framework synthesis was used to identify a best-fit framework developed by a robust methodology and relevant for the agile requirement re-prioritisation process. The chosen best-fit framework considers six factors when prioritising requirements, business value, risk, effort estimation, learning experience, external change, and project constraints. First, the factors considered by the five popular approaches were identified. The results show that five factors were reported in literature for the planning game, three were reported for AHP, one was reported for QFD, and no factors were identified for binary search tree and \$100 allocation. Although the factor business value was not identified in the literature for \$100 allocation or binary search tree, it is likely that stakeholders consider business value for \$100 allocation as they allocate more dollars to the requirements, which are more important. It is also likely that business value is considered for binary search tree, while determining the placement of each candidate requirement on the tree. Second, the factors from the agile requirement re-prioritisation process were compared with the factors considered by the five popular approaches. The results confirm five of the factors identified in the agile requirement re-prioritisation process. The sixth factor, external change, was not reported in the literature for the five popular approaches. The planning game covers five of the factors whereas AHP covers three of the factors. QFD only covered one factor, and both the binary search tree and £100 allocation approaches did not report any of the factors although the binary search tree and \$100 allocation approaches have numerous benefits, including being fast and easy to use. This may influence the choice of approach used for agile requirement re-prioritisation. This study contributes insights that are important for requirement prioritisation literature and practice.

## Chapter 10

Awareness Without Actions: A Qualitative Study on Risk Management in Nordic Software

Startups ..... 168

*Quang-Trung Nguyen, ThuongMai University, Vietnam*

*Thananya Phromwongsa, University of Southern Denmark, Denmark*

*Sharanka Shanmugalingam, University of Southern Denmark, Denmark*

*Victor Steinfeldt Laursen, University of Southern Denmark, Denmark*

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The success and survival of software startup companies depend on the decision-making of entrepreneurs. Risk management is an important part of making both business and product-related decisions. In contrast to the popularity of research on risk management in the context of established organizations, there is relatively limited research on risk management in early-stage startup companies. In this work, we aim at understanding the perception and practices of managing risks in software startups. We interviewed CEOs and CTOs of nine early-stage software startups in Denmark and Norway. The results revealed an awareness of common types of risks among software startups. However, risks are not measured or managed by any established approaches. We found that startups founders do not believe in risk management methods and prioritize other tasks on their to-do list. The findings have direct implications for startup founders in their early stages in Nordic countries.

## Chapter 11

|                                                               |     |
|---------------------------------------------------------------|-----|
| COVID's Scholarly Literature and Innovation in Startups ..... | 182 |
|---------------------------------------------------------------|-----|

*Varun Gupta, University of Alcala, Spain*

*Chetna Gupta, Jaypee Institute of Information Technology, India*

*Lawrence Peters, Software Consultants International Limited, USA & Universidad*

*Politecnica de Madrid, Madrid, Spain*

*Leandro Pereira, ISCTE, University Institute of Lisbon, Lisboa, Portugal*

The importance of scholarly literature on startup capacities to stimulate innovation in pandemic times is highlighted in this chapter. The scholarly literature can help startups looking for opportunities or solutions in the face of a pandemic, but knowledge acquisition from secondary materials may be limited due to the growing number of publications, retractions, and preprints. The growing number of publications and venues makes it more difficult for entrepreneurs to get the information they need, analyse it, and then use collective intelligence to turn it into useful business knowledge. Retractions may steer startups in the incorrect direction, resulting in a waste of financial resources. Preprints are non-peer reviewed research articles that may provide some direction to startups but should not be relied upon entirely. The solutions to these issues are finally provided. Addressing these concerns could make scholarly literature beneficial to startups, allowing the global community to respond to the pandemic as a whole.

## Chapter 12

|                                                                                                        |     |
|--------------------------------------------------------------------------------------------------------|-----|
| IT Technologies in Mechanical Engineering: Impact of IT Technologies on the Engineering Industry ..... | 187 |
|--------------------------------------------------------------------------------------------------------|-----|

*Anastasia Sergeevna Samoylova, Federal State Autonomous Educational Institution of Higher Education, Moscow Polytechnic University, Russia*

*Ekaterina Olegovna Bobrova, Federal State Budgetary Educational Institution of Higher Education Lomonosov, Moscow State University, Russia*

*Valentina Valentinovna Britvina, Federal State Autonomous Educational Institution of Higher Education, Moscow Polytechnic University, Russia*

*Galina Pavlovna Konyukhova, Moscow State University of Technology, Russia*

This chapter reported the innovative IT-technologies in the field of mechanical engineering, allowing to increase the efficiency of production. This chapter reflects a particular task of automation of a particular branch of mechanical engineering – the technology of mechanical engineering. New methods of calculation of typical multivariable tasks are considered as well as the effectiveness of the introduction of automation at the level of the design office.

## Chapter 13

|                                                                                   |     |
|-----------------------------------------------------------------------------------|-----|
| Sixteen Limitations for Five Popular Requirements Prioritisation Approaches ..... | 202 |
|-----------------------------------------------------------------------------------|-----|

*Zoe Hoy, University of Portsmouth, UK*

This chapter pertains to process innovation in requirement prioritisation. The research identifies the limitations associated with five requirements prioritisation approaches, namely analytic hierarchy process (AHP), quality functional deployment (QFD), the planning game, binary search tree, and \$100 allocation. A search of academic literature was conducted to identify sentences and paragraphs describing the limitations. With little research on prioritisation approach limitations, grounded theory was chosen. Verbatim text about the limitations was inductively analysed to identify which were reported for each of the five popular prioritisation approaches. The findings contributed 16 limitations associated with

the five popular prioritisation approaches: nine limitations for AHP and QFD, seven for the planning game, six for \$100 allocation, and four for binary search tree. While analysing these, limitations dependencies were reported among them. For example, the quality of the requirement limitation could impact the validity issues limitation. Therefore, this study also contributes a framework showing these dependencies and how the limitations can impact or influence other limitations. The results could help software developers to understand the limitations of each approach and inform the approach they choose for requirements prioritisation. With the fewest limitations, this study shows that the binary search tree could be the best approach. However, an approach with a high number of limitations may be preferred if the benefits outweigh the limitations. Therefore, further research is needed to provide a balanced view and also consider the benefits of these five popular approaches. Future research could also be used to verify the framework.

## **Chapter 14**

**Technology-Based Innovation for Business Model Innovation ..... 223**

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*Tejaswini R. Murgod, GSSS Institute of Engineering and Technology for Women, India*

*Sowmya M., GSSS Institute of Engineering and Technology for Women, India*

This chapter pertains to technology-enhanced business model innovation. The innovative business model must be capable of producing new business ideas by combining the technology along with the business values so as to come up with solution to new customer requirements. This chapter highlights the trends across the technology innovation, how technology can be a tool for fostering innovation, associated challenges with technology-driven innovation, how to enable IT-enabled innovation in enterprises, and how technology-driven innovation could lead to business growth. Finally, various approaches for innovation are presented.

**Compilation of References ..... 237**

**About the Contributors ..... 275**

**Index..... 280**

## Chapter 6

# Ambidexterity, Knowledge Management, and Innovation in Technology Development Zones: The Case of Turkey

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### ABSTRACT

*This chapter searches how knowledge management and innovation activities, which enable an advantageous position for firms over their opponents, influence ambidexterity and business performance. These enable firms to gain an advantage over their competitors, concerning ambidexterity and organizational performance. The population for this study comprises firms, operating in technology development zones in Ankara, Turkey. According to the sectoral distribution of the enterprises in the technology development zones, the majority operate in the software sector. No sampling methods were used because the census method was adopted. Three hundred sixty high-tech enterprise top managers form the basis of this empirical research. In this study, structural equation modeling was used for testing research model. As a result of the structural equation modeling, it was understood that firms' knowledge management and innovation usage preferences have a positive impact on ambidexterity and organizational performance. This outcome is important for firms to gain a competitive advantage.*

DOI: 10.4018/978-1-7998-9059-1.ch006

## INTRODUCTION

In today's world of intense competition, firms seek to reduce their costs as much as possible while striving to increase their productivity and quality. Therefore, managers have to control many contrasting situations concurrently to sustain the business. The rapid advancement of technology and globalization has brought a new dimension to the competition and firms are attaching more importance to notions such as novelty, creativity, and speed because they pave the way for knowledge as a strategic value. Firms need to implement innovation activities to manage chaos and also enable sustainability.

Nowadays, the concept that is creating a difference between firms is knowledge and the human factor that builds knowledge. Creating, sharing, using, and managing knowledge within firms becomes part of the organizational culture. The fact that knowledge can become a competitive weapon for firms in a globalized world and that capital-intensive firms are replaced by knowledge-intensive firms shows how important knowledge management is for firms. Yet firms can encounter an insufficient knowledge level; there can be a gap between the available knowledge level of firms and the required knowledge level needed to produce new products, processes, or services. Firms need creative studies to close this gap. At this point, the important thing for a firm is the quality and amount of knowledge and how it will be utilized to carry out innovation activities. Because, firms increase their creativity and performance by integrating knowledge management and knowledge processes (Shahzad, Bajwa, Siddiqi, Ahmid and Sultani, 2016).

Creating knowledge is an essential point for creating innovation processes, and innovation management is a critical issue for enterprises. When considered from this aspect, the long-term success of any enterprise is mainly to discover new skills while developing current skills also (Raisch, Birkinshaw, Probst and Tushman, 2009).

Firms need to take advantage of their basic knowledge and as well explore new opportunities by opening doors to new information (Cantarello, Martini and Nosella, 2012). Ambidexterity also handles the innovation and knowledge management that interacts with it as well as the variables affecting ambidexterity. The main feature of successful firms can balance explorative and exploitative strategies (Chang and Hughes, 2012). Anzenbacher and Wagner (2019: 572) highlighted "the ability to balance exploratory and exploitative activities has become more and more crucial for firms in today's increasingly globalized business environment in the face of rapid technological change". Ambidextrous firms can balance and manage exploitation and exploration knowledge (Raisch et al., 2009).

A resource-based approach is a tool by which firms gain an advantage over their competitors by using their internal resources (Barney, 1991). With the resource-based approach, it was tried to explain why some companies are more successful and gain a sustainable competitive advantage (Khan and Zaman, 2020). This study adopts a resource-based approach and a knowledge-based approach and aims to research how knowledge management and innovation activities, which enable an advantageous position for firms over their opponents, influence ambidexterity and business performance. This chapter answer these research questions: whether knowledge management and innovation activities affect ambidexterity and performance of the firm? In this chapter, the relationship between ambidexterity, innovation, knowledge management and firm performance will be examined.

## BACKGROUND

### Knowledge Management and Innovation

Knowledge management practices in firms encompass a series of strategies and initiative activities used for the generation, transfer, apply and storage of knowledge (Donate and Pablo, 2015). Managing knowledge fruitfully increases the innovation capacity of firms (Darroch and McNaughton, 2002; Donate and Guadamillas, 2011). Nonaka (1994) argued that knowledge creation in firms is the basis of innovation and competition. Thus, knowledge management helps firms launch new products and services.

In knowledge-based economies, knowledge is a necessary resource to carry out efficient management policies and practices for firms. Thanks to knowledge management, firms gain innovation-making skills, raise productivity, and consequently achieve a competitive advantage in the medium to long term (Kremp and Mairesse, 2004). Firms aim to develop more innovation activities and create value with their improving knowledge. Subramaniam and Youndt (2005) described innovation as knowledge management processes concerned with defining and using ideas and an opportunity to create new products/services. In this manner, knowledge management is seen as the core of the innovation process and organizational harmony in terms of firms (Earl, 2001).

There are many studies in the literature examining the relationship between knowledge management and innovation (Khan and Zaman, 2020; Hamdoun, Jabbour and Othman, 2018; Durmuş-Özdemir and Abdulkhoshimov, 2018; Mardani, Nikoosokhan, Maradi and Doustar, 2018; Inkinen, Kianto and Vanhala, 2015; Donate and Pablo, 2015; Lai, Hsu, Lin, Chen and Lin, 2014; Yeşil, Koska and Büyükmeşe, 2013; Wang and Wang, 2012; Donate and Guadamillas, 2011; Lopez-Saez, and Castro Delgado-Verde, 2011). Ode and Ayavoo (2020) examined the relationship between knowledge management practices and firm innovation in companies operating in the service sector in developing countries. As a result of the study, knowledge management practices contribute to firm innovation both directly and indirectly. In a recent study conducted by Gürlek and Çemberci (2020), knowledge management efforts in firms turn into innovation performance and consequently into firms performance.

Innovation strongly depends on availability of the knowledge and its recombination leading to products or services in a way that delivers value to the customers. In a pandemic, there is plenty of information that could be converted into knowledge leading to successful commercialisation of innovations in the market. For small sized firms with limited resources, knowledge acquisition and its recombination could be effortful. However, in previous research the startups have used university libraries (Gupta et al., 2021a; Gupta et al., 2022a) and competitor peer startups (Gupta et al., 2021b) as their strategic knowledge partners and have relied on technology adoption for exploring market knowledge (Gupta et al., 2021b; Gupta et al., 2022b) to successfully innovate and survive.

**H<sub>1</sub>:** Knowledge management will have a positive influence on innovation.

### Innovation and Ambidexterity

Robert Duncan, for the first time, mentioned the ‘ambidexterity’ notion to define dual organization structures in the administration and organization literature in 1976 (as cited in Hodgkinson, Ravishandar and Aitken-Fischer, 2014). The notion, coming from the ability to use both the right and the left hand equally, then started to be used as a metaphor in the administration and organization literature (Lubatkin,

### ***Ambidexterity, Knowledge Management, and Innovation***

Şimşek, Ling and Veiga, 2006). Although it is hard to define the ambidexterity notion thoroughly, it is generally agreed that firms can gather their resources and skills to maintain sustainability and achieve success (O'Reilly and Tushman, 2013).

Wernerfelt (1984) emphasizes the significance of balancing the exploitation of existing resources of firms with a resource-based perspective. Subsequently, March (1991) later defined the ambidexterity notion in the literature aftermath of Duncan (1976). March asserted the need to balance explorative and exploitative strategies. These two strategies are considered two subdimensions of a whole. Duncan stressed that there has to be a unit to conduct explorative activities as well as a different unit to conduct exploitative activities for firms to overcome the possible problems of his dual structure. Firms can manage conflicting demands and cost efficiency by using these dual organization structures and therefore any department inside the business can focus on adapting to the changing environmental conditions, whereas another department can focus on alignment (Birkinshaw and Gibson, 2004).

In firms, exploitative activities and exploratory activities contend for scarce resources (Anzenbacher and Wagner, 2019). That is, firms should focus on balanced activities that can both follow and develop innovations and benefit from available skills (Raisch et al., 2009).

The firms that realize their innovation activities in a specific cycle become more talented at innovation making, unlike the firms balancing their exploitative and explorative strategies. Particularly, these firms become more successful in terms of their product innovation (Şimşek, Veiga, Lubatkin and Dino, 2005). While the firms achieving their ambidexterity activities in a cycle allocate more time for exploitative activities, explorative activities prevent explorative activities, and these firms enter into a time loop (Gupta et al., 2006). Technology-based firms, realizing their cyclical ambidexterity period, are more inclined to seek out product innovation, and this situation is considered as an incremental element in business performance (Atuahene-Gima, 2005). When firms give more importance to explorative activities to produce new products, they can produce new products as well as discover new technology (Şimşek et al., 2005). When firms realize their exploitative and explorative activities in a cycle, they avoid a competency trap that results in giving weight to exploitative activities and also a failure trap that results in giving extreme weight to explorative activities (Siggelkow and Levinthal, 2003). Competency and failure trap affect the innovation performance of firms.

Wu, Wood, Chen, Meyer and Liu (2020) investigated the relationship between ambidexterity and innovation on 74 Chinese multinational firms and 60 domestic enterprises. According to the results of the research, ambidexterity has a negative effect on innovation in domestic companies. But this effect is less in Chinese multinational enterprises.

**H<sub>2</sub>:** Innovation will have a positive influence on ambidexterity.

### **Ambidexterity, Knowledge Management, and Firm Performance**

Ambidexterity consists of different learning methods in firms requiring diverse strategies, contexts, and organizational mechanisms (Gupta et al., 2006). Businesses can choose from among ambidexterity strategies by using different learning methods. Whereas firms try to develop their available knowledge and competence using exploitative methods for the sake of developing the available activities, they seek new knowledge for explorative activities. At this point, knowledge management plays a vital role in determining whether firms will go toward exploitative strategies or explorative strategies (Filippini, Güttel and Nosella, 2012).

### ***Ambidexterity, Knowledge Management, and Innovation***

When the importance of knowledge management is acknowledged, it helps firms manage their exploitative and explorative activities and become competitive in a dynamic environment (Cepeda and Vera, 2007). Verona and Ravasi (2003) described knowledge management as organizational regulations encouraging exploitative activities to raise productivity and explorative activities encouraging innovation in firms. Lubatkin et al. (2006) claimed that knowledge management processes solve the conflict between exploitative and explorative innovations. Tushman and O'Reilly (1996) emphasized that efficient knowledge management in firms is necessary for the long-term performance of explorative and exploitative innovation.

Exploitative and explorative strategies, as two subdimensions of ambidexterity, were considered different and competing concepts before March's (1991) study. Later studies understood that these two strategies were not competing with each other and could be balanced and integrated owing to firms' scarce resources (Raisch et al., 2009). March claimed that firms do not need any selection between exploitative and explorative strategies; on the contrary, they should have the skill to manage these two strategies at the same time. When academics explain exploitative and explorative strategies, they make a connection between knowledge management and innovation. They assert that firms should have both strategies to increase their knowledge level. On the one hand, an exploitative strategy can be realized through research and practice of innovation within the confines of available knowledge. On the other hand, an explorative strategy means any research on entirely new information and the production of novelties for firms. Both strategies necessitate the integration of knowledge in the business (Taylor and Greve, 2006).

Cao, Gedajlovic and Zhang (2009) stressed that exploitative and explorative innovation can cause a conflict of resources and place demands on firms and there should be a balance between these two innovation strategies; however, balance can be realized with ambidexterity. Even though it is hard to conduct exploitative and explorative strategies together, one cannot disregard the positive effect of competitive advantage and long-term performance for business (Jansen, Von den Bosch and Volberda, 2005). Many studies concluded that knowledge management affects ambidexterity (Abazeed, 2020; Dezi, Ferraris, Papa and Vrontis, 2019; Soto-Acosta, Popa, Martinez-Conesa, 2018; Oehmichen, Heyden, Georgakakis and Volberda, 2016).

Firms should follow changes and implement them into their business strategies to keep up with the continuous and rapidly changing environmental conditions. They should also seek out new knowledge and skills that will protect their competitive positions while they develop their existing knowledge and skills (Floyd and Lane, 2000). Peng, Lin, Peng and Chen (2019) stressed; "when an organization performs exploration and exploitation actions, it not only improves its operational efficiency but also promotes innovative performance". Firms implement all these activities to achieve good performance.

Severgnini, Galdamez and Vieira (2019) investigated the relationship between ambidexterity and firm performance on 227 software companies. According to the results of this study, ambidexterity increases business performance. This result is similar to Gibson and Birkinshaw's (2004) study, but different from Gupta et al., (2006) and Cao et al., (2009) studies. In the literature, studies are suggesting that ambidexterity affects business performance in a positive direction (Mura, Micheli and Longo, 2020; Junni, Sarala, Taras and Tarba, 2013; O'Reilly and Tushman, 2013; Atuahene-Gima, 2005). Some studies have concluded that there is a negative effect (Wu and Ang, 2019; Wu, Ma, Liu, and Lei, 2019; Menguc and Auh, 2008; Ebben and Johnson, 2005; Van Looy, Martens and Debackere, 2005).

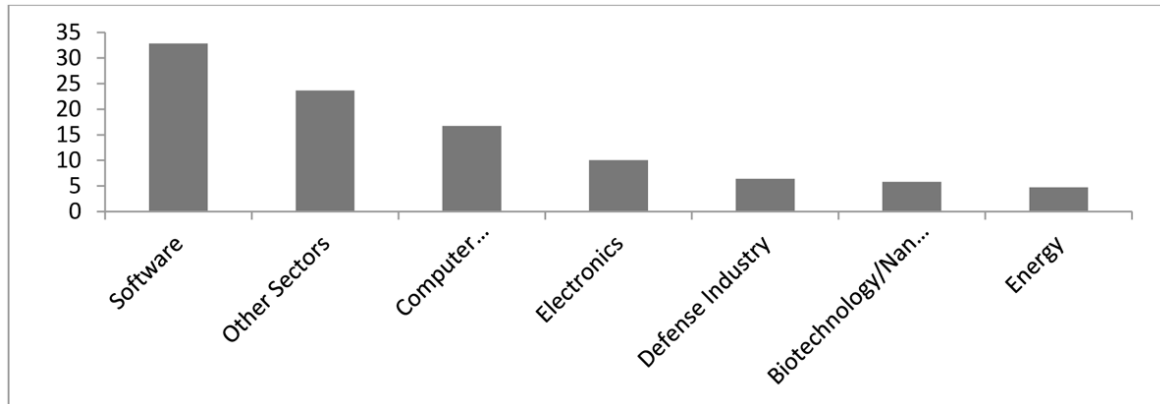
**H<sub>3</sub>:** Ambidexterity will have a positive influence on firm performance.

## METHODOLOGY

### Sampling

The population of the research comprises the firms operating at Technology Development Zones (technopark) in Turkey/Ankara. The reason behind the selection of these firms is that they are established to carry out research and development activities and they are knowledge-intensive firms. The target group in this study is senior executives of the firms operating at Technology Development Zones. Senior executives have a significant role in the strategic decision-making process of the firms (Lubatkin et al., 2006). Because ambidexterity is a strategic choice for firms, senior executives are particularly preferred for this study. There is a total of 970 firms operating at five Technology Development Zones in Ankara. All the questionnaires were delivered by hand to the 360 firms that agreed to participate in the survey. When the sectoral distribution of the firms in these Technology Development Zones is examined, there are many more firms operating in the software sector. Following the software sector, the densest sectors are computer technology and electronics, respectively. These 360 firms were classified into six different sectors (see Figure 1). Wang and Rafiq (2014) emphasized that the firms that apply ambidexterity strategies should be in high-technology sectors. Because firms using high technology were preferred, the study becomes rational.

*Figure 1. Distribution by sectors*



### Method and Measuring Tools

The questionnaire used in this study was created from the preexisting scales found in the literature. The used research model was tested with structural equation modeling (SEM). The reason for using SEM is that structural equation modeling examines the relationship between observed and potential variables. SEM reveals unobtrusive connections (Yu, 2004, Reisinger and Turner, 2009). It is presumed that observed variables in the model measure potential variables. SEM can be used for different strategies in analyses. Jöreskog (1993) proposed a confirmatory modeling strategy, an alternative model strategy, and a model-developing strategy. In this study, a confirmatory modeling strategy was used because it

### ***Ambidexterity, Knowledge Management, and Innovation***

tests the used model whether a data set is confirmed or not. Ambidexterity strategies were measured by 12 items (two dimensions), innovation by 21 items (four dimensions), knowledge management by 55 items (11 dimensions), and firms' performance by four items (one dimension). Information about the scales is given in Table 1.

*Table 1. Information of scales*

| Variable             | Number of Items | Source                    |
|----------------------|-----------------|---------------------------|
| Ambidexterity        | 12              | Lubatkin et al. (2006)    |
| Innovation           | 21              | Lin, Chen and Shun (2010) |
| Knowledge Management | 55              | Lee and Choi (2003)       |
| Firm Performance     | 4               | Lichtenthaler (2009)      |

## **Findings**

Dimension means, standard deviations, and skewness and kurtosis values of the variables in the questionnaire are given in Table 2. Whether the values show normal distribution or not can be understood through skewness and kurtosis values. If the values are between  $\pm 3$ , it shows a normal distribution (Shao, 2002). When the skewness and kurtosis values of variables are examined, one can see that the values are between  $\pm 3$  and therefore the data show a normal distribution.

*Table 2. Descriptive statistics*

| Scale                | Means | Standard Deviation | Skewness | Kurtosis |
|----------------------|-------|--------------------|----------|----------|
| Knowledge management | 3,99  | 0,292              | -0,377   | 0,199    |
| Innovation           | 3,91  | 0,904              | -0,253   | -0,178   |
| Ambidexterity        | 4,14  | 0,496              | -0,233   | -0,261   |
| Performance          | 3,51  | 0,829              | -0,482   | -0,076   |

Whether the data belonging to the scale are suitable for analysis, Kaiser-Meyer-Olkin (KMO) test and also Bartlett's Sphericity (BS) test are applied to whether the data are suitable for factor analysis. Field (2013) stated that the sub-limit of the KMO value should be 0,50. The KMO value is 0,869, and the BS significance value shows that it is suitable for factor analysis. After it was understood that the data were suitable for factor analysis, they were passed to factor analysis. As a result of the analysis, 14 factors were obtained, they can be seen in Table 3.

### ***Ambidexterity, Knowledge Management, and Innovation***

*Table 3. Exploratory factor analysis*

| Variables            | Dimensions                    | Number of Items | Adjusted R Squared | Cronbach Alpha |
|----------------------|-------------------------------|-----------------|--------------------|----------------|
| Knowledge Management | Cooperation-Trust             | 9               | 13,290             | 0,86           |
|                      | Learning                      | 7               | 6,754              | 0,87           |
|                      | Centralization                | 3               | 57,484             | 0,86           |
|                      | T- Type Skill                 | 5               | 42,071             | 0,79           |
|                      | InformationTechnology Support | 5               | 23,420             | 0,85           |
|                      | Externalization               | 7               | 28,412             | 0,83           |
|                      | Internalization               | 4               | 18,372             | 0,84           |
| Innovation           | Product Innovation            | 4               | 53,865             | 0,768          |
|                      | Process Innovation            | 3               | 50,239             | 0,849          |
|                      | Organizational Innovation     | 5               | 33,105             | 0,827          |
|                      | Marketing Innovation          | 4               | 46,433             | 0,861          |
| Ambidexterity        | Exploitative Activities       | 4               | 60,415             | 0,650          |
|                      | Explorative Activities        | 3               | 63,256             | 0,670          |
| Performance          | Performance                   | 4               | 37,700             | 0,887          |

At the end of the factor analysis, the knowledge management scale was gathered under seven subdimensions. Because formalization, socialization, and integration subdimensions' (18 statements) factor load were under 0,500 (Nunnally, 1978), they were excluded from the scale. Cooperation and confidence dimensions were gathered under the same factor, and they were named as factor cooperation-confidence. The innovation scale was gathered under four dimensions. Because factor loads of four statements were under 0,500, they were excluded from the scale. The ambidexterity scale was gathered under two dimensions. Because factor loads of the five statements were under 0,500, they were excluded from the scale. And the scale belonging to business performance was gathered under a single factor.

### **Confirmatory Factor Analysis**

Confirmatory factor analysis measures the relationship between potential variables and observed variables in the model. Statistical Package for the Social Sciences (SPSS) and Analysis of Moment Structures (AMOS) programs was applied for confirmatory factor analysis and goodness-of-fit values belonging to the model were computed. The goodness-of-fit values belonging to the measuring model can be seen in Table 4.

# Ambidexterity, Knowledge Management, and Innovation

Table 4. Confirmatory factor analysis results

| Fit Index   | 1. Degree CFA | 2. Degree CFA | Goodness-fit Indexes*  | Acceptable Fit         |
|-------------|---------------|---------------|------------------------|------------------------|
| $\chi^2/sd$ | 1,427         | 1,342         | $\leq 3$               | $\leq 4-5$             |
| GFI         | 0,817         | 0,848         | $0,95 \leq GFI \leq 1$ | $0,90 \leq GFI < 0,95$ |
| CFI         | 0,921         | 0,943         | $0,95 \leq CFI \leq 1$ | $0,90 \leq CFI < 0,95$ |
| RMSEA       | 0,034         | 0,031         | $RMSEA \leq 0,05$      | $0,05 < RMSEA < 0,10$  |
| SRMR        | 0,052         | 0,058         | $SRMR < 0,05$          | $0,06 < SRMR < 0,08$   |
| RMR         | 0,036         | 0,041         | $RMR \leq 0,05$        | $0,05 < RMR \leq 0,10$ |

When confirmatory factor analysis was employed, some of the goodness of fit values belonging to the model were under acceptable values. As a result of adjustments, a total of seven statements from the knowledge management variable, one statement from the ambidexterity variable, three statements from the innovation activities variable, and one statement from the business performance variable were excluded.

In the aftermath of modifications, goodness-of-fit values took place in the acceptable values (Table 4: 2. Degree CFA). First of all, we examined the chi-square ( $\chi^2/sd$ ) goodness-of-fit test, as the most widely used index, and it was seen that the model was significant. However, because chi-square is highly sensitive to sample size, it is not sufficient alone to evaluate the fit between model and data. For this reason, other fit values were examined too. When the obtained index values were examined for the measuring model, the results were either good or acceptable:  $\chi^2/sd$  value is under 3; RMSEA is under 0,05; CFI value is under 0,95; GFI value is near 0,95, and SRMR value is under 0,08. When the goodness of fit values was analyzed, it was seen that the relationships specified in the model and the data are acceptable

As a result of confirmatory factor analysis, the average variance extracted (AVE) and composite reliability (RE) values of each dimension were computed after goodness-of-fit values were between acceptable values (Table 5). Construct validity, in the meantime, was tested with AVE and CR. Hair, Black, Babin and Anderson (2009) claimed that the AVE value should be over 0,50 and the CR value should be over 0,70. Besides, the CR value should be over the AVE value in each dimension. When Table 5 is examined, AVE values of cooperation-confidence (AVE: 0,43), T-type skill (AVE: 0,46), externalization (AVE: 0,35), product innovation (AVE: 0,47), organizational innovation (AVE: 0,43), explorative activities (AVE: 0,48), and exploitative activities (AVE: 0,41) should be under 0,50 for all variables but Fornell and Larcker (1981: 46) impressed on “based on  $p_n$  (composite reliability) alone, the researcher may conclude that the convergent validity of the construct is adequate, even though more than 50% of the variance is due to error”. The CR values should be over 0,70 for all variables. The model performs another circumstance for construct validity that the CR value should be higher than the AVE value for all variables.

### Ambidexterity, Knowledge Management, and Innovation

Table 5. CR and AVE values

| Variables            | Dimensions                     | AVE  | CR   |
|----------------------|--------------------------------|------|------|
| Knowledge Management | Cooperation-Trust              | 0,43 | 0,87 |
|                      | Learning                       | 0,52 | 0,64 |
|                      | Centralization                 | 0,72 | 0,88 |
|                      | T- Type Skill                  | 0,46 | 0,81 |
|                      | Information Technology Support | 0,56 | 0,86 |
|                      | Externalization                | 0,35 | 0,79 |
|                      | Internalization                | 0,50 | 0,83 |
| Innovation           | Product Innovation             | 0,47 | 0,78 |
|                      | Process Innovation             | 0,62 | 0,83 |
|                      | Organizational Innovation      | 0,43 | 0,79 |
|                      | Marketing Innovation           | 0,60 | 0,85 |
| Ambidexterity        | Exploitative Activities        | 0,48 | 0,73 |
|                      | Explorative Activities         | 0,41 | 0,73 |
| Performance          | Performance                    | 0,72 | 0,91 |

### Path Analysis

The existence of one-way causal relationships in the proposed model was tested by path analysis. Goodness-of-fit values were computed together with the path analysis. The  $\chi^2/df$ , RMSEA, SRMR, RMR, CFI, and GFI values are given in Table 6 were within the acceptable range. In this manner, one can see that the set model is confirmed.

Table 6. Fit index values and goodness fit values for the structural model

| Fit Index           | Fit Index Values | Goodness-fit Indexes*  | Acceptable Fit         |
|---------------------|------------------|------------------------|------------------------|
| $\chi^2$ değeri (p) |                  | $p > 0,05$             | -                      |
| $\chi^2/sd$         | 1,356            | $\leq 3$               | $\leq 4-5$             |
| GFI                 | 0,847            | $0,95 \leq GFI \leq 1$ | $0,90 \leq GFI < 0,95$ |
| CFI                 | 0,940            | $0,95 \leq CFI \leq 1$ | $0,90 \leq CFI < 0,95$ |
| RMSEA               | 0,031            | $RMSEA \leq 0,05$      | $0,05 < RMSEA < 0,10$  |
| SRMR                | 0,058            | $SRMR < 0,05$          | $0,06 < SRMR < 0,08$   |
| RMR                 | 0,042            | $RMR \leq 0,05$        | $0,05 < RMR \leq 0,10$ |

When the index values are examined for the structural model (Table 6), it is seen that the results are good or acceptable.  $\chi^2/sd$  value is under 3; RMSEA is under 0,05; CFI value is under 0,95; GFI is near 0,90 and SRMR value is under 0,08.

### ***Ambidexterity, Knowledge Management, and Innovation***

As a result of the analysis, the effect of knowledge management over innovation ( $\beta_1:0,98$ ) is positive and significant; the effect of innovation over ambidexterity ( $\beta_1:0,50$ ) is positive and significant; and the effect of innovation over business performance ( $\beta_1:0,64$ ) is positive and significant. Regression coefficients of ambidexterity, innovation activities, knowledge management, and business performance variables were computed within the context of the research scope to test the relations among them. Table 7 shows variables, regression coefficient, standard error values, and probability values.

*Table 7. Path coefficients and significance levels of the predicted structural*

| Variables       |                      | Std.Regression Coefficient | Std. Error | Sig. Level |
|-----------------|----------------------|----------------------------|------------|------------|
| Innovation ←    | Knowledge Management | 0,563                      | 0,208      | <0,001     |
| Ambidexterity ← | Innovation           | 0,741                      | 0,097      | <0,001     |
| Performance ←   | Ambidexterity        | 0,283                      | 0,176      | <0,001     |

\*\*\*  $p < 0,001$

As a result of regression analysis, we concluded that there is a positive effect of knowledge management over innovation; a positive effect of innovation over ambidexterity; and a positive effect of ambidexterity over business performance according to probability values. The most significant way to contribute can be decided along with standardized regression coefficients. When standardized coefficient numbers are examined, it is clear that the most contributing innovation activity to the model is ambidexterity.  $H_1$ ,  $H_2$  and  $H_3$  hypotheses were accepted according to the analysis results.

## **FUTURE RESEARCH DIRECTIONS**

Additional studies may obtain different results when comparing the firms operating at Technology Development Zones across Turkey and the world. Firms in different sectors using high technology can be used for future studies. Increasing studies in different sectors make it easier to compare results. Future studies can be designed by addressing cultural differences. A longitudinal sample collected at the point at different times will help support this research objective. Future studies could also take into consideration looking separately at different dimensions of exploration and exploitation strategies. The research population consists of the senior managers of the enterprises. However, other observation groups, such as customers, can be included in the research to fully understand the innovative activities of a business. A similar study could also be replicated in other industries such as manufacturing, aviation, food industry, and hospitality etc.

## **CONCLUSION**

This study aimed was to research the effects of firms' ambidexterity and business performance by using knowledge management and innovation. As a result of the analysis within the context of a designated

### ***Ambidexterity, Knowledge Management, and Innovation***

model, we concluded that there is a positive and significant effect of knowledge management over innovation; a positive and significant effect of innovation over ambidexterity; and a positive and significant effect of ambidexterity over business performance. After the model was put through the structural equation modeling linearity hypothesis, it was clear that going through innovation activities to ambidexterity has a greater impact compared with other ways.

Nonaka, Toyama and Konno (2000) asserted that there is a positive relationship between the efficient use of knowledge and innovation inside a business. Knowledge has become the most important resource today, and it is important to obtain, spread, evaluate, and store knowledge that is the keystone of innovation. Hargadon and Sutton (1997) claimed that new knowledge presents creative solutions and consequently paves the way for innovation for firms. Therefore, firms can adopt new competencies or they can develop their current competencies thanks to new knowledge. There are many studies in the literature examining the relationship between knowledge management and innovation (Ode and Ayavoo, 2020; Gürlek and Çemberci, 2020; Khan and Zaman, 2020; Hamdoun et al., 2018; Durmuş-Özdemir and Abdulkhoshimov, 2018; Mardani et al. 2018; Inkinen et al., 2015; Donate and Pablo, 2015; Lai et al., 2014; Yeşil et al., 2013; Wang and Wang, 2012; Donate and Guadamillas, 2011; Castro et al., 2011). Innovation and knowledge management are significant for firms to develop new products as well as their current products. Firms undertake these activities to improve their performances.

Similar results were gained in comparisons with the studies in the literature. In the studies that support a positive effect of knowledge management over innovation, Lubatkin et al. (2006) claimed that knowledge management processes solve the conflict between exploitative and explorative innovations; similarly, Tushman and O'Reilly (1996) thought that efficient knowledge management in firms is necessary for long-term performance of exploitative and explorative strategies.

When examining the effect of ambidexterity over business performance, both He and Wong (2004) and O'Reilly and Tushman (2013) concluded that ambidexterity has a positive effect on business performance. There are studies in the literature that found similar results with this study. (Mura et al., 2020; Junni et al., 2013; Stettner and Lavie, 2013; Jansen, Van den Bosch and Volberda, 2006; Atuahene-Gima, 2005; Auh and Menguc, 2005; Gibson and Birkinshaw, 2004; Benner and Tushman, 2003; Lewin and Volberda, 1999; Tushman and O'Reilly, 1996). But some studies have concluded that there is a negative effect (Wu and Ang, 2019; Wu et al., 2019; Menguc and Auh, 2008; Ebben and Johnson, 2005; Van Looy et al., 2005).

Besides contributing to the literature, the study also has limitations. The results of this research cannot be generalized for all sectors. This research examined the firms operating at Technology Development Zones in Ankara (Turkey) province. The study covers only a limited area. Different regions can be selected as samples. Thus, studies embodying different regions can be compared.

In today's world of intense competition, firms pass through several transformations. These transformations give more weight to producing more qualified products/services and developing new strategies and innovation. The firms, giving more importance to innovation, use knowledge management more efficiently, and seek out new competencies while developing their existing competencies. The complexity and dynamism of the firms' environment can prevent their transformation from short- to long-term success. Thanks to ambidexterity, the firms have an opportunity to both transfer their present successes into the future and adapt to possible environmental changes that can be realized in the future at the same time (Jansen et al., 2005).

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***Ambidexterity, Knowledge Management, and Innovation***

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## **KEY TERMS AND DEFINITIONS**

**Dual Organization Structures:** They are organizational structures that contain dynamic and stable structures.

**Dynamic Capabilities:** It is supported by the organizational routines and management skills of businesses.

**Exploitative Strategies:** Is a strategy of exploit.

**Explorative Strategies:** Is a explore strategy.

**Knowledge-Intensive Firms:** They are companies that find intangible solutions to customers' problems by using the knowledge of their employees.

**Technology Development Zones:** It is an organization that provides opportunities for entrepreneurs, academics and those who want to do research.

**Technology-Based Firms:** They are businesses that maintain the process of technological innovation.

***Ambidexterity, Knowledge Management, and Innovation***

**ENDNOTE**

- <sup>1</sup> This study is based on the Ph.D. dissertation under the title “The Choice of Strategic Ambidexterity in the Perspectives of Knowledge Management and Innovation: a Research in Ankara Technology Development Zones”.