

T.C.
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YÖNETİM VE ORGANİZASYON (İNGİLİZCE) BİLİM DALI

**EFFECTS OF TECHNOLOGICAL INNOVATION CAPABILITIES ON
ORGANIZATIONAL AGILITY: A RESEARCH FOCUSED ON THE
R&D CENTERS IN TURKEY**

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ABSTRACT

This research explores the effects of technological innovation capabilities on organizational agility. The study aimed to evaluate the extent to which the functional and dynamic innovative capabilities of the organization increase the proactive, responsive, radical and adaptive capabilities of the firms. In order to measure innovative capabilities in detail, R&D centers in Turkey were chosen as a sample. In the light of the data collected from a total of 320 executive-level employees, it has been found that organizing, manufacturing and marketing skills have significant and positive effects on organizational agility.

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ÖZET

Bu araştırma, teknolojik yenilik yeteneklerinin örgütsel çeviklik üzerindeki etkilerini keşfetmektedir. Çalışma, örgüte ait fonksiyonel ve dinamik inovatif yeteneklerin firmaların proaktif, yanıt verebilir, radikal ve adapte olabilir becerilerini ne ölçüde arttırdığını değerlendirmeyi amaçlamıştır. Yenilikçi yetenekleri ayrıntılı bir şekilde ölçebilmek için türkiyedeki ar ge merkezleri örneklem olarak seçilmiştir. Toplamda 320 adet yönetici seviyesindeki çalışandan toplanan verilerin ışığında, organize etme, imalat ve pazarlama yeteneklerinin örgütsel çeviklik üzerinde belirgin ve pozitif yönlü etkilere sahip olduğu bulunmuştur.

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LIST OF ABBREVIATIONS

CFA: Confirmatory Factor Analysis

CFI: Comparative Fit Index

df: Degree of Freedom

EFA: Exploratory Factor Analysis

KMO: Kaiser-Meyer-Olkin Criterion

OECD: The Organization for Economic Cooperation and Development

RBV: Resource-Based View

RMSEA: Root Mean Square Error of Approximation

SCA: Sustained Competitive Advantage

SRMR: Standardized Root Mean Square Residual

TIC: Technological Innovation Capabilities

TLI: Tucker-Lewis Index

1. INTRODUCTION

The occurrence of the fourth industrial revolution made it hard to argue with the fact that enterprises started going through a period where many stereotypical concepts in the business world are completely replaced by new models. New digital technologies are developing new business models and profoundly changing the whole value chain, from product development to supply chain management, from manufacturing and distribution to customer experience. With the emergence of Industry 4.0 in 2011, various new technologies entered the agenda of the firms and some existing technologies improved their importance such as the internet of things, big data and analytics, augmented reality, additive manufacturing, cloud, cybersecurity and autonomous robots (Rüßmann *et al.*, 2015). Statistics show that the number of devices connected to the worldwide network increased their volume from 800 million in 2010 to 16.4 billion in 2022 and expected to be approximately 30 billion devices in 2025 (IoT-Analytics Research, 2022). These developments can be interpreted as analog or mechanic technologies leaving their places to digital structures which are easier and faster to change and adapt. While these transformations are proven useful for the companies dramatically, they also created a dependency of innovation and speed. Companies are arguably expected to be more innovative than ever before to keep their competitive advantages. This necessity created the need for organizations to be able to use their organizational capabilities rationally in order to stay one step further in front of their rivals.

Change intervals of the parameters in the external environment decreased greatly which created results of shorter product life cycles, the necessity of new and differentiated product or service developments. Consequently, with the connection of the consumers around the world through social media, the web and the globalization of markets, the preferences of the customers began to alter greatly. Thus, technological innovations in the business world can be regarded as advantageous for many firms but also pose a great risk for companies that show lower responsiveness and slower action-taking behavior. Digital transformation and disrupting changes in the business world force companies to continuously stay on alert for sustainability.

As a result, rapid change rates in technological, sociocultural, financial and political forces are more demanding than ever before. It can be easily interpreted that even a natural parameter such as the Covid-19 pandemic deals a huge blow to firms that cannot adapt to the new conditions fast and soundly. The pandemic forced employees to fulfill their responsibilities

from a certain distance. These condition updates set off some events such as a rise in uncertainty, population mobility and fluctuation in financial markets. Organizations that possess agile characteristics found it easier to formulate and execute necessary strategies to adapt to new environmental conditions. Thus, the concept of organizational agility proved its criticality one more time against the always-transforming business conditions.

In this sense, this study is meant to identify the relationship between the organizational capabilities which enable a firm to develop technological innovations and their effects on the dynamics of organizational agility. Based on the fact that organizations are expected to sustain their sustainability by using their organizational capabilities in an effective and efficient manner, the results of these activities on the organizations' ability of proactiveness, responsiveness, and adaptiveness is also a crucial interaction to be discovered to emphasize the vital capabilities to improve organizations' flexibility and agility levels. Since the organizational agility is the company's capability to react to market challenges in accordance with the suppliers and other stakeholders within a timely action (Irfan *et al.*, 2019, p. 115), thus, agility is an ongoing process of development and a necessity for survival instead of an option (Harraf *et al.*, 2015, p. 675). In another aspect, technological innovation capabilities are defined as an extensive array of firm attributes that assist company's technological innovation strategies (Burgelman *et al.*, 2004). In an overview, firms that can manage their organizational capabilities in order to create and adopt innovations are supposed to gain a higher competitive advantage but their effects on the agility of an organization still remains undetermined.

1.1. STRUCTURE OF THE THESIS

In this section, brief information about the structure of the thesis is going to be given. The dissertation is going to be presented under seven main titles which are the introduction, literature review for technological innovation capabilities, literature review for organizational agility, theoretical background, methodology with research findings, discussion, and conclusion.

In the introduction section, the necessity of the research is going to be summarized with the discussion of the research background. The research gap in the studies will be briefly pointed out and the conceptual relationship between technological innovation capabilities and organizational agility of a firm will be identified and the criticality of the relationship will be emphasized.

In the literature review section, previous studies with significant importance will be reported regarding the technological innovation capabilities and organizational agility concepts. To be able to clearly define and discuss the variables, studies with different points of view will be emphasized and the similarities and differences will be explained regarding the organizational capabilities that enables the technological innovation capacity, and organizational agility level of a firm.

In the methodology section, the steps of the sample selection, instrument selection, data gathering, executed statistical analyses and research findings will be presented at the end of each different stage of analyses such as EFA, CFA, discriminant and convergent validity analyses and structural equation modelling. At the end of the methodology section, hypotheses that are supported and rejected will be presented.

In the discussion section, the results of the research findings will be summarized, and the possible logical reasons for these results will be interpreted and discussed. While, to the knowledge of the researcher, there is no existing study which investigated the relationship between technological innovation capabilities and organizational agility in the same model so far, the comparison of the results with similar research is not going to be possible. Furthermore, theoretical implications and practical implications will be indicated with the limitations and future directions.

In the conclusion section, final word about the study is presented from a holistic point of view.

1.2. RESEARCH BACKGROUND

1.2.1. Regarding Studies Executed in Turkey

When the research executed specifically in Turkey are examined which focused on the investigation of the agility concept in different approaches, it is easy to prove that the importance of the agility concept in business administration discipline is gaining more importance year by year.

When the thesis database of the Council of Higher Education in Turkey is scanned, it can be seen that there are 48 dissertations are present which focused on several different types of the agility concept. The fact that of the 48 theses published, 31 of them were written in the

last 3 years, is proof that the concept has become a top priority in the agenda of studies conducted in Turkey.

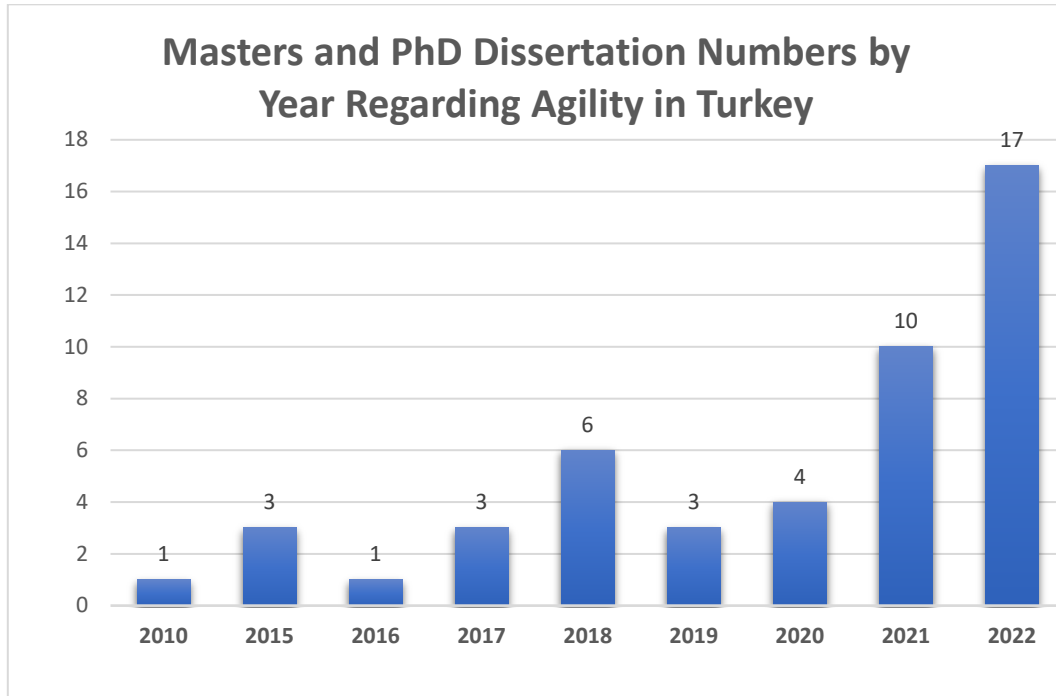


Figure 1 – Dissertation Statistics by Year Regarding Agility in Turkey

Source: Council of Higher Education – Thesis Center (tez.yok.gov.tr)

When these studies concerning different types of agility are examined, four main types of agility stand out. Organizational agility, comprising 28 out of 48 studies, is the most common and wide-ranging type of agility. This is followed by supply chain agility with 9 studies and strategic agility studies with 8 studies. Lastly, there are three more thesis studies conducted in Turkey regarding workforce agility and marketing agility topics.

With a brief overview, it can be said that the concept rapidly gained importance in studies in Turkey and strengthened its place in the academic literature. In addition, the fact that organizational agility provides a broader perspective by considering the whole organization rather than a part of it allows for more holistic results across the organization.

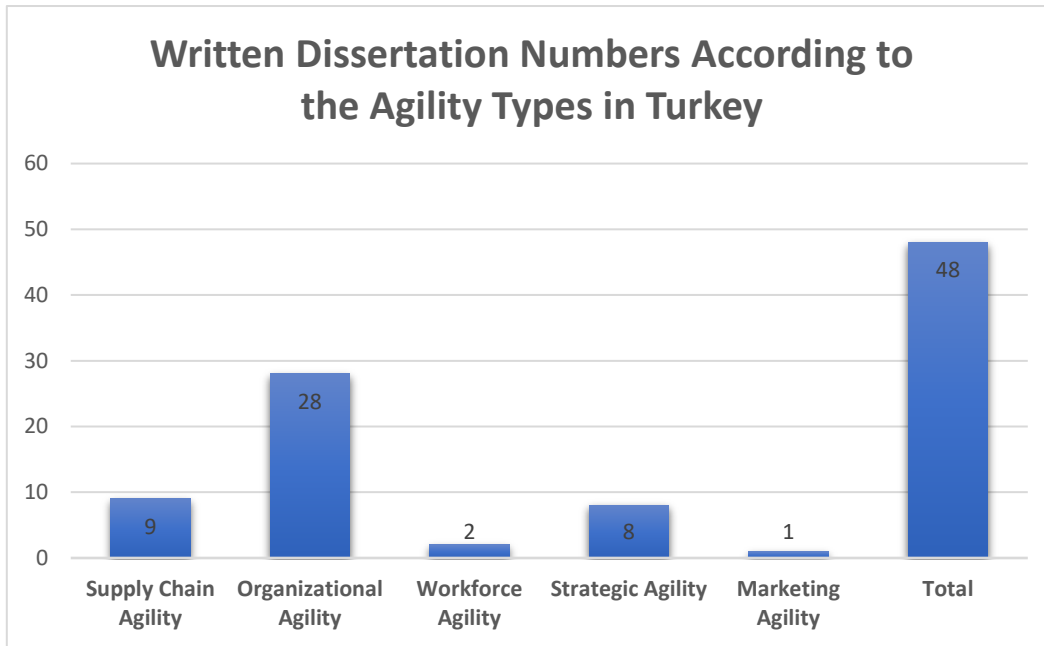


Figure 2 – Dissertation Statistics According to the Agility Types

Source: Council of Higher Education – Thesis Center (tez.yok.gov.tr)

1.2.2. Research Gap

When a general literature review is made, it can be easily deduced that there are numerous studies that consider the subject of technological innovation capabilities within international academic studies. However, in the scope of studies conducted in Turkey, the subject of technological innovation capabilities is investigated in very few studies while it can be easily determined that a study investigating the effects of technological innovation capabilities on organizational agility has not been conducted yet.

The importance of the research can be easily understood since the changing rate of the parameters in the external environment increases in an exponential rate rather than a linear one which results in the necessity for organizations to respond faster to these changes and in most of the time create proactive action plans before the changes even occur in the real life.

The aim of the study is to determine the technological innovation capabilities necessary to transform the risks and threats created by the external environment into opportunities and advantages that will increase the company's survival probability by being healthily perceived

by the organizations and, to investigate the effects of these capabilities on the company's rapid reaction and adaptation abilities.

While in-depth information will be given in the literature review section regarding the studies conducted in the investigation of technological innovation capabilities and organizational agility variables, to point out the necessity of this research, a brief information will be provided regarding the studies executed in Turkey.

With the continuous technological changes in the external environment accelerating due to fast innovations, the necessity to cope with these changes is critical for firms. Organizations' need for adaptation to these unpredictable rapid changes made agility a key business driver for all organizations (Ganguly, Nilchiani and Far, 2009), and gaining agile abilities has become essential for organizations to sustain their competitive advantage and endure the fast changes which can pose a threat for the firm (Panda and Rath, 2018).

To the knowledge of the researcher, although agility gained high importance in foreign literature, there is still only a limited amount of research present in Turkey. Also, in studies seen in foreign literature, many different aspects are chosen to investigate the relationship with organizational agility but a research model covering the relationship between technological innovation capabilities and organizational agility still remains as a gap.

1.2.3. Purpose of the Study

The aim of this study is to investigate the impact of technological innovation capabilities on the agile behaviors of enterprises. In addition to this, a closer look to the effects of the capability types on the different agility aspects will be taken.

Therefore the following research questions are expected to be answered through this dissertation;

- What are the organizational agility levels of the firms operating as research and development centers in Turkey?
- What are the technological innovation capability capacities of the firms operating as research and development centers in Turkey?
- Do technological innovation capabilities possess a significant effect on the organizational agility levels of the research and development centers?

- Which technological innovation capabilities are more critical for the organizations' proactive, radical, responsive and adaptive behavior?

To the knowledge of the researcher, when compared with the foreign studies, a limited number of researches done in Turkey point out that there is a lack of focus on the organizational agility concept (Akkaya and Tabak, 2018; İşcan and Karabey, 2006), hence it can be understood that the importance of the topic is still not comprehended decently in Turkish literature.

Panda and Ruth (2018) emphasize the importance of the concept as follows; "Agility has become indispensable for almost every organization to survive in persistently changing and competitive environments". Since the speed of technological changes increasing, their effect on the firms' agility is a critical subject to be examined.

To the best of the researcher's knowledge, although there are existing studies in the literature that focused on different antecedents of organizational agility, there is a gap that needs to be filled concerning the relationship between technological innovation capabilities and organizational agility. Since this study is focused on the dynamic capabilities of an organization, it is meant to focus on a unique relationship between the innovative capabilities and the agility dynamics which is a conceptual framework that hasn't been investigated before. To obtain satisfactory answers about the variables, R&D centers are especially chosen since technological innovation capabilities under an organization's structure include complex functions such as research and development capability, manufacturing capability and strategic planning capability under its construct. Thus, it is planned to reach a more consistent data, compared to random organizations operating in various industries.

2. TECHNOLOGICAL INNOVATION CAPABILITIES

In this section, the literature review for the technological innovation capabilities concept will be presented. At the beginning, brief information about the concept of innovation will be given. Following that, the types of technological innovation present in the literature will be discussed. Furthermore, the information about the most acknowledged and cited definitions and approaches of technological innovation capabilities will be presented.

2.1. INNOVATION CONCEPT IN THE LITERATURE

Innovation is a concept that has been studied for a long time and has been examined from many perspectives. In a brief explanation, innovation is defined as the generation, dissemination, and application of innovative ideas in the economy and it refers to new manufacturing techniques, new goods, new organizational structures, and new markets (Nielsen and Lundvall, 2003). In order to examine the details of the concept in a brief way, the definitions made in the literature will be explained.

Schumpeter (1934) defines innovation as introducing a new product to the market or the modification done to an existing product. In addition, Schumpeter states that innovation can also be a new process in the sector, detection of new sources of supplies, and even developments in the organization. According to Damanpour and Evan (1984), innovation is a broad notion that may be defined in a variety of ways to reflect the unique requirements and characteristics of specific research. Furthermore, Damanpour (1991) states that the innovation concept is the creation and application of new ideas and approaches by enterprises. Acs and Audretsch (1988) discuss that innovation is a method that starts with the creation of a new product or service, continues with its improvement, and concludes with the launch of this new product, method, or service on the market. Moreover, Lumpkin and Dess (1996, p. 142) argue that innovation can be defined as a procedure that adds value and uniqueness to a business, its vendors, and consumers through establishing new processes, solutions, goods, and services, as well as new forms of marketing approaches.

De Jong and Kemp (2003) state that towards any organizational level, innovation behavior may be described as all individual acts focused on the production, introduction, and implementation of useful novelty. Hage (1999) argues that innovation can be referred to as a

new product, service, technology or administration process. Palmberg (2004) draws the boundaries of the concept more clearly by defining innovation as a technologically new or considerably improved product with respect to the company's prior product version which is reached a level of commercialization in the market.

In summary, although there is no single concurringly accepted definition of innovation in the literature, general characteristics covering most of the definitions refer to the attributes like new and original features added to a product or a service, novel and value adding organizational features (creative and efficient structures, business models, procedures) and new strategic approaches used in the industries.

2.2. TYPES OF INNOVATION

Technological innovation can emerge from numerous sources and take multiple forms. Each technological innovation can offer different types of opportunities for every firm (Schilling, 2016). In literature, there are different perspectives which try to explain technological innovation from different angles but none of them agreed upon concurringly.

Dodgson, Gann and Salter (2008) state “managers need to understand how the innovation process is changing and how firms can search amongst the many different sources of innovation. And they need to appreciate the various outcomes of innovation, including how they are diffused and adopted by individuals and firms.” Thus, fundamentals of innovation concept and different aspects in the innovation types will be discussed in the next section. Each technological innovation type needs different knowledge to build upon and have various effects on organizations, competitors and customers (Schilling, 2016). In the literature, there are six common approaches which is going to be explained in the following section.

2.2.1. Product Innovation versus Process Innovation

Product innovations represents newer and/or better products released into the market. They may include new materials for the goods or better intangible service ways (Hage *et al.*, 2006). While, process innovations are the improvements or entirely new patterns in the production of goods and services when compared to the existing production methods. Process

innovations are represented by technological and organizational innovations by the taxonomy created by Hage *et al.* (2006). In this taxonomy, authors state that “only goods and technological product innovations are material” while innovations in services and organizational innovations remain intangible.

Types of Innovations			
Product Innovation		Process Innovation	
In goods	In services	Technological	Organizational

Figure 3 – Types of Innovation

Source: Hage *et al.* (2006).

Product and process innovations are closely linked in many occasions. New products such as equipment or machinery may create a better and innovative opportunity for the existing processes (Schilling, 2016). Also, same technological innovation may be a product innovation for one firm while a process innovation for another. Schilling (2016) states that “product innovations are often more visible than process innovations, both are extremely important to an organization’s ability to compete.”

2.2.2. Radical Innovation versus Incremental Innovation

Radical and incremental innovation types are arguably one of the most used approach in innovation literature. First stated by Freeman in his book *The Economics of Industrial Innovation* in 1974, it is accepted by most researchers in the following studies.

Dodgson *et al.* (2008) defines the radicalness of an innovation as “the extent to which a technology has changed, or the degree of novelty of an innovation. Radical innovations include breakthroughs that change the nature of products and services.” In this context, Incremental innovations indicates the small improvements in the products or processes which improves the performance in the long run by building over each other.

Also, Schilling (2016) defines radical innovations as “the combination of newness and the degree of differentness” in products or process innovations. From the literature, it can be

understood that there is no distinct difference between radical and incremental innovations but instead radical and incremental innovations are placed on the opposite sides in a continuum. Schilling also states, “a technology could be new to the world, new to an industry, new to a firm, or new merely to an adopting business unit”, thus, radicalness of an innovation also may change from the point of reference. Furthermore, in the industry, the radicalness of an innovation is also affected by time, thus Schilling finalizes with the argument; “an innovation that was once considered radical may eventually be considered incremental as the knowledge base underlying the innovation becomes more common.” (Schilling, 2016)

Dodgson *et al.* (2008) stated in their book *The Management of Technological Innovation: Strategy and Practice* that “although in practice there are no hard and fast distinctions between incremental and radical innovation and they are best considered as different ends of a continuum, managing the extent and the various types of innovation requires different skills and resources” (Dodgson *et al.*, 2008). In their book Dodgson *et al.* also indicated main characteristics of the incremental and radical technological innovations in the table 1.

Table 1 – Incremental and Radical Innovation Characteristics	
Incremental Innovations	Radical Innovations
Attempting to achieve cost savings rather than direct competition.	Determination to accept fresh concepts from outside the company and industry.
Modifying the design in modest ways.	Constant surveillance of the technological and commercial environment.
Developing organizational patterns, methods, and standards for increased productivity and profitability.	Making choices on future outcomes by investing in an array of technologies.
Including new functions in current goods	Developing novel ties and associations within systems of innovation
Re-innovating the previously released designs and releasing them to consumers as soon as possible.	Restructuring the organizational frameworks so that some divisions conduct research.

Branding.	Adding novel capabilities by means of acquisition or employment
Creating a solid reputation for product excellence.	Investment in novel technological parts somewhat distinct from current practice.
Gaining insight from consumers and users.	Establishing outside-of-industry partnerships and connections.
	Awareness of novel consumer behavior patterns.

Source: Dodgson *et al.* (2008)

In literature, the radicalness of the innovation is pointed out in many studies but a precise definition was never made. For example, radical innovation means the high degree of the originality (Green *et al.*, 1995; Abernathy, 1978; Hage, 1980). Also Hage states that (as cited in Green *et al.*, 1995) “if an innovation takes the firm into areas where there is little knowledge about the new technology or novel routines are demanded of the organization, the innovation is likely to be seen as more radical”.

While the product or process innovation and radical or incremental innovation approaches are preferred more likely in the academic studies, there are still several more uncommon approaches present in the literature to conceptualize the different types of innovations such as competence enhancing or competence destroying innovation, continuous or discontinuous innovation, architectural or component innovation, and open or closed innovation. Also, brief information about these innovation types will be provided in the next sub-headings.

2.2.3. Competence-Enhancing Innovation versus Competence-Destroying Innovation

Some innovations can be systematized as “**competence enhancing innovations**” or “**competence destroying innovations**” (Schilling, 2016). As their labels imply the relationship competence enhancing innovations are build upon the existing technological knowledge of the organization while competence destroying innovations are more radical and disrupts the already

used technologies in the organization. Applied researches which use this classification are very rare in the literature.

2.2.4. Continuous versus Discontinuous Innovation

Continuous versus discontinuous innovations are quite similar to competence enhancing versus competence destroying innovations. Tushman and Anderson (1986) argue that continuous innovations improve the existing methods used in the organization while discontinuous innovations end the current methods and replace them with better ones. Christensen (1997) also makes a similar classification but labels the dimensions as sustaining versus disrupting innovations.

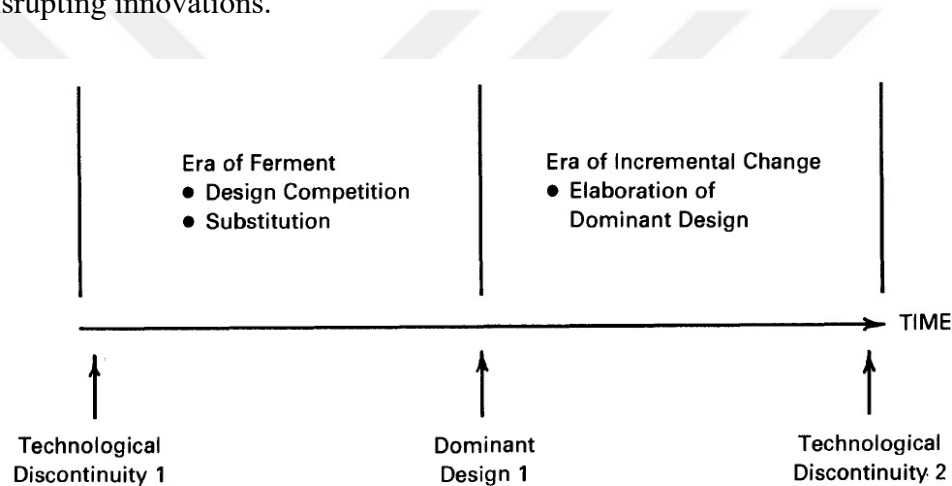


Figure 4 – Technology Cycle

Source: Anderson and Tushman (1990)

2.2.5. Architectural Innovation versus Component Innovation

Architectural versus modular innovation classification is proposed by Henderson and Clark in 1990. This classification is mostly based on the innovation concerning product design. Architectural innovation represents the changes on the design of the product while preserving all components as the same. Schilling (2016) uses the example of fan used in the rooms for air flow. While all components remain the same, entirely new architectural design allows ceiling fan to be born. This is the basic logic behind architectural innovations. As can be understood,

component innovations represent the innovated new parts which are used in the same product architecture.

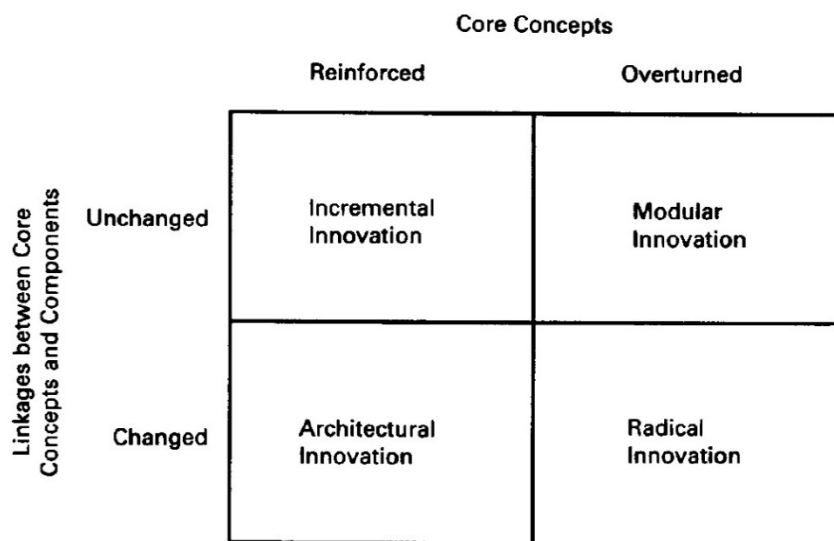


Figure 5 – A Framework for Defining Innovation

Source: Henderson and Clark (1990)

Henderson and Clark proposed a framework concerning the relationship between architectural vs modular innovations and incremental vs. radical innovations. While incremental and radical innovations represent the changes in core concepts of the technologies like reinforcing the existing one or overturning it with an entirely new one, architectural and modular innovations in technologies represent the relationships between core concepts and components of the products or processes.

2.2.6. Open versus Closed Innovation

Chesbrough (2003) points out the importance of the change in innovation strategies and categorizes innovation as open or closed innovations.

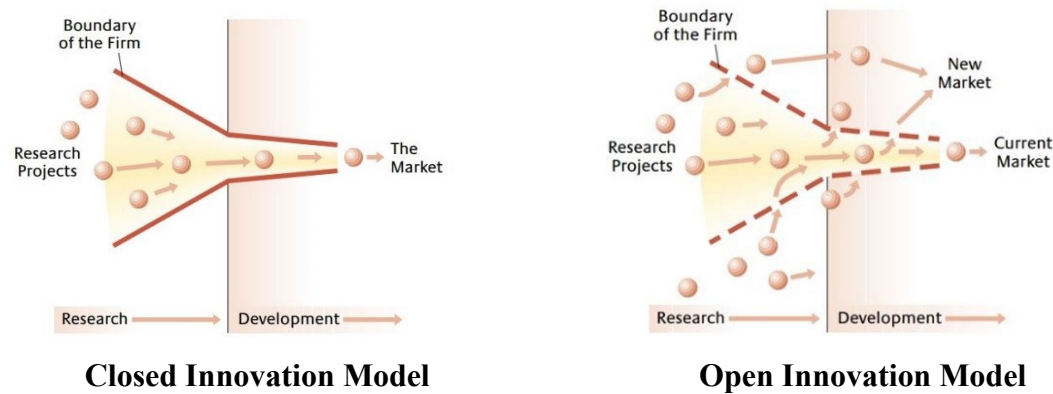


Figure 6 – Closed vs Open Innovation Models

Source: Chesbrough (2003)

Chesbrough (2003) states that a closed innovation occurs when a business originates, develops, and monetizes its own ideas and adds that in the majority of the twentieth century, this self-reliant concept controlled the R&D activities of many major industrial enterprises. In the contrary, in open innovation model, a corporation commercializes both its own ideas and those of other companies and explores methods to get its in-house ideas to market by deploying paths outside of its present operations. Chesbrough (2003) notes that the barrier between the corporation and its surroundings is permeable (presented with a dashed line in the figure), allowing ideas to flow more readily.

2.3. MEASURING INNOVATION

In literature, there are numerous studies done with different methodologies to measure innovation. Studies are divided into three main categories of innovation measurement which are 1) Research and Development Statistics, 2) Patent numbers of the firms and 3) Surveys.

Dodgson *et al.* (2008) point out the main difficulties in their book *Management of Technological Innovation*. Researchers indicate several main inconsistencies which negatively affect the measurement process. Positive effects of the innovation are hard to be seen until a specific period of time passes. In addition, the term “innovation” does not represent the same meaning for everyone in the process. Also, some studies focus to the inputs for innovation while others only accept the outputs. In addition to the indications of Dodgson *et al.*, it can also be added that some technological innovations are just regular improvements for a group of company while some are radical developments for others (Schilling, 2016).

2.3.1. R&D Statistics

R&D statistics differ between some specifications such as amount of investment in the R&D department or in a certain project, or number of employees working in the R&D department. Dodgson *et al* (2008) point out that because of the absence of a commonly accepted R&D definition, also measuring innovation by statistics is quite challenging. Because of this misguidance OECD's Frascati Manual proposed a common definition for R&D as "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture, and society, and the use of this stock of knowledge to devise new applications" (OECD, 2002, p. 30). It examines the procedures under R&D in three main categories (Dodgson *et al.*, 2008). These categories are labelled as basic research, applied research and experimental development research. Basic definitions of the concepts are as follows;

Basic research refers to any investigation, whether experimental or theoretical, that is carried out with the primary goal of acquiring new information on the fundamental causes of observed events and facts. This kind of study does not have a specific application or goal in mind. In addition, applied research refers to the original investigation conducted to acquire new knowledge, with a primary focus on achieving a particular practical goal or objective. On the contrary, experimental development research represents the systematic effort aimed at creating, enhancing, and implementing novel materials, goods, and services. It draws on prior knowledge acquired from study and real-world experience (Dodgson *et al.*, 2008).

2.3.2. Patent Data

Patent data is one of the most preferred measures in studies while quantifying the level of innovations. In literature, there are numerous studies measuring innovation with the count of patent data (Abraham and Moitra, 2001; Johnstone *et al.*, 2012; Park *et al.*, 2005; Archibugi, 1992; Chen *et al.*, 2009; Chen *et al.*, 2007; Jun and Park, 2013). While having some positive sides such as description or functionality of the innovation, patent data also have some loopholes. Dodgson *et al.* (2008) state that: "the disadvantage of patents as a measure of innovation is, as we saw in the case of mousetraps, that most patents are not commercialized. Patents are therefore better seen as a measure of invention rather than innovation."

2.3.3. Innovation Surveys

While there are many surveys in literature focused on measuring various types of innovation, a questionnaire specifically measuring technological innovation is missing. Dodgson *et al.* (2008) indicates that the early researches focused on measuring innovation were using “object-oriented” approach which meant counting all innovations separately by using surveys. After the early 90s, tendency to use innovation surveys increased which were ‘subject oriented’ because they were asking firms directly about their innovative activities (Kleinknecht and Mohnen, 2002; Smith, 2005; Dodgson *et al.*, 2008). Most of these surveys were based on the Oslo Manual which were setting out guidelines for the questionnaire (OECD, 2013).

2.4. TECHNOLOGICAL INNOVATION CAPABILITIES

In this section, technological innovation capabilities concept will be discussed in detail. Multiple definitions with similar and distinct properties will be presented. Furthermore, arguably the most used or cited technological innovation capability constructs will be discussed. And finally, the subfactors of the construct used for this study will be defined in detail.

2.4.1. Definitions of Technological Innovation Capabilities

In order to draw the boundaries of the concept, several most cited definitions of the variable are going to be explained.

Technological Innovation Capability is one of the most essential research areas in the field of technological innovation management (Mortzavari Ravari, Mehrabanfar, Banaitis and Banaitiené, 2016). Previous researches in the literature show that while there are many different Technological Innovation Capability (TICs) definitions existing, most of the researchers agree on the notion that it is a multi-directional complex concept (Ince, Imamoglu and Turkcan, 2016). Chen, Wang and Huang (2019) state that numerous studies have employed a variety of single concepts to characterize TICs, but these concepts have rarely been precisely defined. In harmony with this statement, Burgelman, Maidique, and Wheelwright (2001, as cited in Chen *et al.*, 2019) and Shafia, Shavvalpour, Hosseini and Hosseini (2016) argue that TICs are a

multidimensional concept which represents an organization's actions of innovativeness those can't be measured by a sole parameter.

Burgelman *et al.* (2004, as cited in Yam, Guan, Pun and Tang, 2004) define TICs as a thorough collection of attributes that enable and support an organization's technological innovation approaches. Guan and Ma (2003) define TICs as a kind of specific assets or resources that contains "technology, product, process, knowledge, experience and organization".

Technological innovation capability is defined as an organization's capacity to increase its ability to innovate in technology and develop new consumer value offers by introducing new products and services, implementing new technologies, or cultivating new skills and competencies (Perdomo-Ortiz, González-Benito and Galende, 2009). Concordantly, in their study, Aziati, Tasmin, Bee Jia and Abdullah (2014) define TIC as the capability to consistently convert knowledge and innovative notions into unique brands, products, processes, and systems with the assistance of technology for the organization's and its stakeholders' benefit.

Liu and Jiang (2016) state that previous research has demonstrated that certain TIC resources are crucial for new product introduction and product competitiveness. According to the study of Yam *et al.* (2004) research and development capability and resource allocation capability are shown to be the most critical abilities affecting an organization's TIC (Liu and Jiang, 2016). These capabilities existing in the enterprises are appropriate to be evaluated on organization-level (Siallagan, Silaban and Ali, 2019).

In their study, Liu and Jiang (2016) drew attention that in his competitive advantage theory, Porter (1990) argued that only firms with core competencies can obtain an advantage over the world's top competitors in the face of pressure and difficulty. Thus, long-term, technological innovation capability is a significant source of competitive advantage (Freeman, 1994).

2.4.2. Main Approaches in the Literature

When a search is made on the international academic literature, it is determined that a lot of research has been done on the subject of technological innovation capabilities. As can be understood from the definitions in the previous section, in addition to the absence of a common definition, it is obvious that there is also no common factorial sub-dimension approach. For that

matter, in this section, the most significant TIC approaches and their subfactors will be explained which are also summarized in the Table 2.

Chiesa *et al.* (1996, p. 115) presented a comprehensive model with 7 sub-dimensions in their study to evaluate technological innovation performance. The sub-dimensions in the study aim to measure the innovation performance of the organization from a broad perspective, including concept development, product development, production process innovation, technology acquisition, leadership, resourcing and systems and tools. Concept generation represents new product ideas and product development approaches created within the organization. Product development emphasizes the time-to-market of developed concepts, the time between concept, design, initial production, and product presentation. It also aimed to measure the entire manufacturing process, including product and design performance. Process innovation represents the efficiency, speed and continuous improvement of activities throughout the production process. Technology acquisition emphasizes the number of licenses and patents the firm holds and the efficiency of its R&D activities. Leadership, on the other hand, aimed to highlight the percentage of employees who are aware of innovation policies and values, as well as the number of pages devoted to innovation and technology in annual reports. Resourcing aims to identify the percentage of projects that are delayed or cancelled due to lack of funds or human resources. And lastly, systems and tools is conceptualized to identify designers or engineers with access to CAD screens, the percentage of products found in the CAD database, certified processes, etc.

Panda and Ramanathan (1996, p. 565) state that an evaluation regarding the technological innovation capabilities of a business will provide management with valuable insights considering the current state of the company's technological prowess, its degree of growth, the efficiency of different learning mechanisms, and the level of technological capability that must be achieved to stay viable. In this sense, researchers presented four main capabilities in their study for the assessment of technological innovation capabilities of an organization. This four-dimension approach is composed of strategic technological capabilities, tactical technological capabilities, supplementary technological capabilities and steering capability. Although, in the first layer the main model is evaluated under four factors, it can be investigated that there are also second-layer capabilities. Panda and Ramanathan have divided the strategic technological capabilities and tactical technological capabilities dimensions into three more detailed sub-dimensions, while the supplementary technological capabilities dimension has been divided into two. Strategic technological capabilities are composed of

creation capability, design and engineering capability and construction capability while tactical technological capabilities is composed of production capability, marketing and selling capability and servicing capability. Supplementary capabilities focused on the acquisition and supportive capabilities which are aimed to identify the acquired technologies, raw materials, spare parts, financial and human resources. Supportive capabilities are representing the training, strategic planning, networking and, safety and security activities.

In their study, Burgelman *et al.* (2001) proposed a framework for capabilities of innovation expected to be evaluated under five dimensions. These factors are resource availability and allocation, capacity to understand competitor innovative strategies and industry evolution, capacity to understand technological developments, structural and cultural context and, strategic management capacity.

Based on the studies of Chiesa *et al.* (1996) and Burgelman *et al.* (2001), Guan and Ma (2003) formulated a new framework to expand the details of the activities representing the organizational capabilities that support technological innovations. In their innovation audit, Guan and Ma (2003) presented seven main dimensions which are also used in many of the following studies in the literature. This audit is composed of learning capability, R&D capability, manufacturing capability, marketing capability, organizing capability, resource allocation capability and strategic capability. This audit is expanded in the further studies of Yam *et al.* (2004), Guan *et al.* (2006) and Yam *et al.* (2011). Furthermore, in their studies, Yam *et al.* (2011, p. 394) created a categorization and labelled the previous technological innovation capability approaches under three main groups as asset approach, process approach and lastly functional approach. The asset and process approaches, according to the researchers, are significantly more complicated to understand than the functional approach. They emphasize that not only is the last approach simpler to comprehend, but it also enables adoption of the multi informant approach utilized in the assessment carried out for this study (Yam *et al.* 2011, p. 393). This conceptual approach is also chosen for this study to assess the functional and organizational capabilities that promotes the capacity of technological innovation in an organization, and will be examined in detail in the next section.

In their approach, Zhang and Zhou (2007, as cited in Gökuç, 2011) state four different dimensions as resource allocation capability, R&D capability, output production capability and marketing capability. As can be reviewed, three out of four capability types are based on the previous functional approach of Guan and Ma (2003) and Yam *et al.* (2004).

Table 2 – Main TIC Approaches Found in the Literature	
Researchers	Technological Innovation Capability Approaches
Chiesa <i>et al.</i> (1996)	• Concept development • Product development • Production process innovation • Technology acquisition • Leadership • Resourcing • Systems and tools
Panda and Ramanathan (1996)	• Strategic technological capabilities • Tactical technological capabilities • Supplementary technological capabilities • Steering capability
Burgelman <i>et al.</i> (2001)	• Resource availability and allocation • Capacity to understand competitor innovative strategies and industry evolution • Capacity to understand technological developments • Structural and cultural context • Strategic management capacity
Guan and Ma (2003), Guan <i>et al.</i> (2006)	• Learning capability • R&D capability • Manufacturing capability • Marketing capability • Organizing capability • Resource allocation capability • Strategic capability
Yam <i>et al.</i> (2004) Yam <i>et al.</i> (2011)	• Learning capability • R&D capability • Resource allocation capability • Manufacturing capability • Marketing capability • Organizing capability • Strategic planning capability

Zhang and Zhou (2007, as cited in Gökuç, 2011)	• Resource allocation capability • R&D capability • Output production capability • Marketing capability
Deng and Wang (2007, as cited in Gökuç, 2011)	• Input capability • R&D capability • Manufacturing capability • Marketing capability • Output capability • Administrative innovation capability
Wang <i>et al.</i> (2008)	• R&D capability • Innovation decision capability • Marketing capability • Manufacturing capability • Capital capability
Shan and Jolly (2010)	• Investment capability • Production capability • Networking capability

Source: Adapted from the Studies of Gökuç (2011) and Bil (2018).

Similar to the previously emphasized relationship, Deng and Wang (2007) also focused on the functional approach and included R&D capability, manufacturing capability and marketing capability. In addition to that, they also added input and output capabilities referring to the inbound and outbound capacities of the organization for indicating the organizational efficiency. Lastly, administrative innovation capability represents the novel managerial technics to organize the entire organization which stays similar with the organizing and strategic planning capabilities present in the study of Yam *et al.* (2011). In a more recent study, Wang *et al.* (2008) updated the construct with inclusion of innovation decision capability and capital capability.

Lastly, Shan and Jolly (2010), in their study, focused on supportive capabilities rather than exact functions of an organization such as investment capability, networking capability and production capability.

Although, literature possess much more alternative constructs and subfactors for the technological innovation capabilities, from a point forward, the concepts used are starting to

repeat themselves. Only with minor changes, researchers seem to use the same conceptual ideas in foundation. Thus, the next subheading will mainly focus on the construct used in this study.

2.4.3. Subfactors Used in the Study

While there are numerous studies in literature focusing on the evaluation of technological innovation capabilities of an organization, it is quite hard to say that there is one commonly accepted methodology. Although there are still studies outside these boundaries, Yam *et al.* (2011) indicated that three main approaches can be identified covering most of the studies.

The first view focusing on the concept is identified as asset approach by Yam *et al.* (2011) regarding the study of Christensen (1995) as the main contributor. In this approach, Christensen focused on three main aspects to evaluate the TIC which are determined as science research asset, product innovation asset and esthetics design asset. By taking into consideration that this study was of the earliest research trying to investigate the concept, arguably most of the researchers agreed upon that it was insufficient to explain required fragments of the main variable (Yam *et al.*, 2011; Faridah and Yuserrie, 2017).

Process approach emerged by the contributions of the studies of Chiesa *et al.* (1996) and Burgelman *et al.* (2004, 2008). Regarding the dimensions used in these studies, it can be seen that, importance of the technological innovation capability factors started to change to organizational factors such as resource allocation and strategic management. While it is accepted to be easier to understand, process approach was still not a mutually agreed methodology.

Compared to further approaches, it can arguably be said that asset approach is somewhat limited in explaining technological innovation capabilities of an organization with detailed subfactors, since the approach only focuses on quantitative parameters such as patent count, R&D investment and limited innovative activities.

While process approach is accepted to be much more definitive than asset approach, it still focuses on limited sections in organization (Yam *et al.*, 2004). Mostly comparing the input and output levels of R&D process activities limits the approach from clarifying in depth relations of the important aspects of technological innovation capabilities of an organization.

Although the approach is similar to functional view in certain ways, it lacks the combination of the required organizational activities which are in close relation with the innovation capability.

Functional approach is arguably the most complex view in the technological innovation evaluation approaches. At the same time, it can be accepted as the easiest approach to explain and understand the relationship of the subfactors composing technological innovation capabilities of an organization.

In the literature, it can be seen that there are several studies done by researchers to evaluate the factors building effective technological innovation capabilities of an organization. One of the most thorough and precise (and also cited) study belongs to Yam *et al.* (2004) which was further developed on following years (Yam *et al.*, 2011; Lau *et al.*, 2010).

Also in this study, functional approach of Yam *et al.* on technological innovation capabilities is found appropriate to evaluate the functional parameters composing subfactors of the variable.

Yam *et al.* indicated seven main dimensions to measure the core attributes of an organization which are expected to improve the technological innovation capabilities, such as an organization's learning capability, resource allocation capability and strategic management capability.

In the table 3, referenced from the study of Shafia *et al.* (2016), it can be clearly seen that there are numerous researchers who contributed to the factors which are explaining the technological innovation capabilities of an organization, Yam *et al.* (2004) were one of the earliest researchers to combine all of these dimensions under a single TIC variable.

Table 3 – Factors used for assessing Technological Innovation Capabilities

Learning capability	Guan et al. (2006), Wang, Lu, and Chen (2008), Yam et al. (2004), Yam et al. (2011), Zahra and George (2002), Levitas and McFadyen (2009), Kim et al. (2011), Forsman (2011), Lin et al. (2012), Sumrit and Anuntavoranich (2013)
R&D capability	Guan et al. (2006), Wang, Lu, and Chen (2008), Yam et al. (2004), Yam et al. (2011), Zahra and George (2002), Levitas and McFadyen (2009), Kim et al. (2011), Forsman (2011), Lin et al. (2012), Sumrit and Anuntavoranich (2013)
Resource allocation capability	Chiesa, Coughlan, and Voss (1996), Barney and Clark (2007), Burgelman, Maidique, and Wheelwright (2004), Guan et al. (2006), Dobni (2008), Wang, Lu, and Chen (2008), Ceylan and Koc (2007), Yam et al. (2011), Spyropoulou and Kyrgidou (2012), Voudouris et al. (2012), Sumrit and Anuntavoranich (2013)
Manufacturing capability	Lin (2004), Yam et al. (2004), Guan et al. (2006), Dobni (2008), Wang, Lu, and Chen (2008), Yam et al. (2011), Forsman (2011), Mu and Di Benedetto (2011), Kim et al. (2011), Sumrit and Anuntavoranich (2013)
Marketing capability	Lin (2004), Yam et al. (2004), Guan et al. (2006), Dobni (2008), Wang, Lu, and Chen (2008), Yam et al. (2011), Forsman (2011), Kim et al. (2011), Sumrit and Anuntavoranich (2013)
Organising capability	Guan et al. (2006), O'Regan, Ghobadian, and Sims (2006), Burgelman, Maidique, and Wheelwright (2004), Yam et al. (2004), Yam et al. (2011), Ceylan and Koc (2007), Dobni (2008), Spyropoulou and Kyrgidou (2012), Türker (2012), Sumrit and Anuntavoranich (2013)
Strategic planning capability	Burgelman, Maidique, and Wheelwright (2004), O'Regan, Ghobadian, and Sims (2006), Ceylan and Koc (2007), Dobni (2008), Yam et al. (2004), Yam et al. (2011), Türker (2012), Sumrit and Anuntavoranich (2013)

Source: Shafia *et al.* (2016)

In order to understand these factors, definitions from the multiple researchers in the literature are summarized in this section.

2.4.3.1. Learning Capability

Yam *et al.* (2004) and Yam *et al.* (2011) define learning capability of an organization as the identification, assimilation and exploitation of the knowledge from the environment (Faridah and Yuserrie, 2017; Lau *et al.*, 2010; Velasquez *et al.*, 2011). For an effective technological innovation, learning capability is accepted as a crucial factor for TIC, since it indicates the main process of knowledge management.

Under this construct, learning capability represents the activities such as systematical monitoring and assessment of the technological changes occurring in the industry, integration of the organization's technological capabilities with the market needs and obtaining necessary knowledge via the experiences.

2.4.3.2. R&D Capability

This capability is defined as the organization's ability of integrating research and development strategy, project implementation, project portfolio management and the expenditure based on research and development activities (Yam *et al.*, 2004; Yam *et al.*, 2011; Faridah and Yuserrie, 2017; Lau *et al.*, 2010; Velasquez *et al.*, 2011; Shafia *et al.*, 2016).

Under this construct, R&D capability activities are developed in a very detailed manner. Organizational routines that represents this capability can be summarized as the mechanisms of development of technology, quality and feedback processes, efficient communication and teamwork between the R&D personnel, transferring the developed novel technologies to the manufacturing department, and so on.

2.4.3.3. Resource Allocation Capability

Resource allocation capability is the organizations' ability of acquiring and allocating necessary and appropriate capital, expertise and technology (Yam *et al.*, 2004, Yam *et al.*, 2011). In other words, resource allocation represents the necessary financial resources, human resources and technological resources in the organization and their effective use in innovation activities (Faridah and Yuserrie, 2017).

Under this construct, resource allocation capability emphasizes the human resources related activities, acquiring and allocating financial resources, cost efficiency aspects and exploiting the external technologies.

2.4.3.4. Manufacturing Capability

While this capability is mainly based on the manufacturing activities of an organization, in some studies, it is used as production capability as well. Yam *et al.* (2004) and Yam *et al.* (2011) define the capability as the company's ability to apply the research and development results into products and services, in order to answer the market needs, reflecting the design requests or specific demands (Faridah and Yuserrie, 2017; Lau *et al.*, 2010; Shafia *et al.*, 2016; Aziati *et al.*, 2014; Guan and Ma, 2004). While using the same dimensions, in their study, Velasquez *et al.* (2011) altered manufacturing capability as production capability. They indicated that the capability also explains the new production techniques, product quality improvement, qualification level of production department and product cycle time (Velasquez *et al.*, 2011; Wang *et al.*, 2008).

Under this construct, manufacturing capability indicates several activities such as the integration with R&D department, overall quality control, capacity of the machinery and equipment, and manufacturing methodologies.

2.4.3.5. Marketing Capability

Yam *et al.* (2004) and Yam *et al.* (2011) define marketing capability as “a firm’s ability to publicize and sell products on the basis of understanding consumer needs, the competitive environment, costs and benefits, and the acceptance of the innovation” (Faridah and Yuserrie, 2017; Lau *et al.*, 2010; Velasquez *et al.*, 2011; Shafia *et al.*, 2016). They emphasized that market knowledge, marketing intelligence services, after sale services and brand and corporate image are the important factors for a strong and efficient marketing capability of an organization.

Under this construct, marketing capability covers the activities such as the knowledge flow and relationship between the department and major customers, efficiency of the sales force and distribution channels, and distribution of the marketing information.

2.4.3.6. Organizing Capability

Yam *et al.* (2004) and Yam *et al.* (2011) define organizing capability as “a firm’s ability in securing organizational mechanism and harmony, cultivating organization culture, and adopting good management practices” (Faridah and Yuserrie, 2017; Lau *et al.*, 2010; Velasquez *et al.*, 2011; Shafia *et al.*, 2016). While underlining the importance of the harmony between departments in the organization Yam *et al.* (2004) also indicate that tracking multiple innovation projects is also necessary.

Under this construct, organizing capability covers the organization-level activities such as flexibility of the structure, flexibility and autonomy of the work groups, coordination of the departments and overall progress tracking for the innovation projects.

2.4.3.7. Strategic Planning Capability

Strategic planning is one of the most important capability taking role in technological innovations (Burgelman *et al.*, 2004) defined as “a firm’s ability to identify internal strengths and weaknesses and external opportunities and threats, formulate plans in accordance with corporate vision and missions, and adjusts the plans for implementation” by Yam *et al.* (2004; Yam *et al.*, 2011). An organization with clear goals and the ability to respond external environment quickly are crucial aspects of strategic planning capability.

As a summary, multiple organizational capability factors are put together to create a holistic approach regarding the organizational activities which can support and expand the technological innovation capacity of an organization.



3. ORGANIZATIONAL AGILITY

The advent of the fourth industrial era accelerated the pace of evolution for every element in the organizations' exterior environments. According to Harraf *et al.* (2015), business organizations do not have the luxury of deciding whether or not they should be agile in the 21st century. The structure of the marketplaces has been significantly altered as a result of recent technological advancements, innovative corporate strategies, and economic volatility in multiple sectors (Zitkiene and Deksnys, 2018). Some businesses see the possibilities presented by these rapid and recurring shifts, while others view them as significant dangers in their line of work. Since it's essential for enterprises to remain in compliance with such modifications, they are expected to remain responsive at all times. It is now important for a company to be able to identify risks, generate swift decisions, and rapidly shift its labor force, and it is also vital for an organization to be able to swiftly perform the necessary responsibilities (Nafei, 2016).

Although it is a substantial obstacle for businesses to achieve exceptional levels of competitive dominance and enhanced corporate efficiency (Walter, 2021), it is also a further challenge for them to accomplish this in a short amount of time. Therefore, businesses that cannot act quickly run the risk of sacrificing both a portion of their target market and their advantage over the competition because of inefficiencies in the way they carry out their day-to-day operations (Rafi *et al.*, 2022).

When it comes to maintaining your competitive edge in the industry, recognition and comprehension of such shifts are just as important as the reaction time and integration ability that the company can offer. As a result, the notion of organizational agility has gained significance in recent years in scholarly writings for the purpose of conducting in-depth studies to analyze the reaction speeds, preemptive abilities, and rapid adaptation capacities of enterprises in order for them to continue existing in the current hyper-competitive ecosystem.

There has been a rise in demand for metrics that can assess a company's degree of agility in response to the increasing importance of proactive behavior. In this regard, the purpose of this research is to adapt and validate an existing measure for use with Turkish enterprises. The information about the measurement tool regarding the conceptual subfactors and items of the questionnaire will be given in further chapters.

3.1. EMERGENCE OF THE AGILITY CONCEPT

The idea of agility was brought to light by a 1991 study from the Iacocca Institute that identified the following concepts as the modern standards for competition: "continuous change," "rapid response," "quality improvement," and "social responsibility" (Sharifi and Zhang, 1999). Though early research only applied the idea to the manufacturing industry, it has since been extended to other contexts. According to Goldman *et al.* (1995) agility is the capability of an organization to operate successfully in an aggressive marketplace with consistently shifting customer trends while Yusuf *et al.* (1999) defines agility as the effective investigation of competing grounds (velocity, adaptiveness, innovativeness, proactiveness, quality and profit) by integrating configurable assets and experience management in order to deliver client-centered goods and services in a competitive marketplace that is subject to rapid change. Furthermore, Mrugalska and Ahmed (2021) argued that organizational agility is a firm's adaptability and its capacity to respond and succeed in the face of disruption and unpredictability.

Furthermore, Menor *et al.* (2001) asserted that as a prerequisite for an enterprise to obtain characteristics of agility, it must be able to excel in customer service, quality, adaptability, and costs simultaneously and cohesively. Sambamurthy *et al.* (2003) identified organizational agility to be the capacity of a business to rapidly reconfigure existing methodologies or construct entirely novel ones for the purpose of prospering and enduring in intensely unstable markets. Parallel to Sambamurthy *et al.*, according to Mathiyakalan *et al.* (2005), agility refers to a company's ability to recognize prospects and dangers in the exterior ecosystem and, as a result, develop reactions that are targeted and delivered in a prompt manner to the company's consumers and other relative stakeholders while these reactions are generated by modifying resources, operations, and strategies.

A significant issue in the study of organizational agility is the inability of researchers to compare their results due to essentially divergent views on the main research topic (Podsakoff *et al.* 2016). In that matter, organizational agility definitions that are most cited and main approaches with different perspectives that are found in the literature will be explained in the following two sections.

In the literature, it can be deduced that new studies create new types of agility continuously to examine the different parts of the organization. Different types of agility such as supply chain agility, manufacturing agility, organizational agility, workforce agility,

marketing agility can be found in various studies. Since, this study focuses on organizational agility, definitions and different approaches will be presented accordingly.

3.2. ORGANIZATIONAL AGILITY

In this section, detailed definitions of the organizational agility concept will be presented in detail. In addition, main approaches with different points of view will be summarized and discussed. Finally, the main construct and the subfactors used in this study will be presented.

3.2.1. Definitions of Organizational Agility

Agility concept was created as a manufacturing ability in the report prepared by the Iacocca Institute in 1991. When the report first presented, it created the opinion that concept must be well rooted in management theories (Yusuf *et al.*, 1999). Regardless, the study made many scholars investigate the agility concept in a manufacturing context.

Even though it can be said that the increasing necessity of the organizational agility for sustaining competitive advantage is a common agreement between researchers, an agreement is missing on a mutual definition (Baskarada and Koronios, 2018).

Goldman *et al.* (1995, as cited in Lu and Ramamurthy, 2011) explain organizational agility as a firm-wide capability to counter environmental changes with fast and innovative responses for transforming these threats into opportunities to grow.

Kanani (2016) defined organizational agility as “organization’s ability to survive and prosper in an environment of constant change”.

Felipe *et al.* (2016) state that organizational agility is based on two main concepts; organizational adaptability and organizational flexibility. Since organizational agility concept consists of reactive and proactive attitudes, agility is considered to be one of the critical capabilities of an organization (Sherehiy *et al.*, 2007, Felipe *et al.*, 2016). Moreover, the necessity of agility is closely in a relationship with the increasing pace of change of the environmental factors (Baninam and Amirnejad, 2017).

Baloch, Meng and Bari (2018) defined organizational agility as the “firm’s ability of continuously improving work and infrastructure to transfer, adjust, and respond to the turbulent

environment”. Lu and Ramamurthy (2011) define organizational agility as an organization’s capability to endure to the unforeseen changes in the external and internal environment.

In order for a quick and easy summarization of the concept, table 4 represents arguably the most significant definitions of the organizational agility concept. Even though, there is no exact consensus between the researchers, definitions show high level of similarities with minor differences.

Table 4 – Definitions of Organizational Agility	
Author (Year)	Definitions
Cho <i>et al.</i> (1996)	Agility refers to the ability to adapt swiftly and successfully to an ever-evolving marketplace that is being propelled by goods and services designed by the consumers (p. 323)
Feng and Zhang (1998)	In a setting where change is constant and uncertain, an agile company can quickly adapt by reorganizing its operational activities, procedures, and business partnerships (p. 893)
Gunasekaran (1998)	Agility refers to the ability to endure and thrive in an environment of competition characterized by persistent and unforeseen fluctuations by responding swiftly and efficiently to dynamic markets, powered by goods and services that are shaped according to the consumer preferences (p. 1223)
Dyer and Shafer (1998)	Organizational agility refers to the capability to adjust to new circumstances without undergoing internal transformation. It is regarded as an essential central competency for businesses that operate in exterior surroundings that are constantly changing. Agile organizations make it a priority to cultivate an inbuilt capability to shift, stretch, and modify in response to

	changing conditions, either on their own or in collaboration with strategic partnerships (p. 6)
Sharifi and Zhang (1999)	Agility is the capability to adapt to unanticipated shifts to withstand unforeseen industrial environments, and to exploit changes as prospects. (p. 9)
Bessant <i>et al.</i> (2000)	Ability of an organization to gain a competitive edge by strategically, swiftly, and proactively grasping openings and responding to risks (p. 11)
Hormozi (2001)	Organizational agility emphasizes being able to successfully restructure business activities, procedures, and corporate partnerships while also prospering in constantly changing environmental conditions (p. 132)
Gunasekaran and Yusuf (2002)	Organizational agility refers to the ability of a firm which focuses on proactive developments of virtual manufacturing accompanied with a viable production system to accomplish the following; - match the evolving market conditions - enhance the degree of consumer services - reduce product costs to compete internationally and boost the company's chances of long-term success and financial gain. (p. 1362)
Lin <i>et al.</i> (2006)	The capacity of a business to respond quickly to shifting consumer and market requirements. (p. 355)
Van Oosterhout <i>et al.</i> (2006)	Being capable of foreseeing or react to shifting conditions with comfort and promptness. (p. 134)
Zhang and Sharifi (2007)	Agility is a strategical method of manufacturing that attempts to grant manufacturing businesses with an edge in competition necessary to benefit from dynamic and constant alterations to the business setting, whether in a way of reacting or proacting (p. 352)

Lu and Ramamurthy (2011)	The ability of an organization to respond rapidly and creatively to unforeseen changes in its commercial environment by viewing these changes as opportunities for growth and prosperity. (p. 933)
Teece <i>et al.</i> (2016)	An organizational capability which attempts to efficiently and effectively reassign or reroute its assets to generating, preserving and acquiring value through higher-yield activities in response to internal and external conditions (p. 17)
Sindhwani and Malhotra (2017)	The capacity to survive and thrive in a competitive setting that is characterized by constant and improbable shifts by adapting swiftly and effectively to shifting marketplaces that are pushed by "customer-defined" goods and services. (p. 467)
Nejatian <i>et al.</i> (2018)	The capability of an organization to withstand and succeed in an aggressive, chaotic setting by adapting rapidly and successfully to any form of change, whether foreseeable or unanticipated, in the appropriate and timely manner (p. 202)

Source: Adapted from the work of Walter, 2021.

In the conceptual study of Sambamurthy, Bharadwaj and Grover (2003), agility is defined as the capability of detecting and responding to opportunities and threats in the external environment with quickness and surprise, and examined under three main aspects as; *customer agility, partnering agility and operational agility*. Sambamurthy *et al.* (2003) stated that agility is the capability of exploration and exploitation of opportunities in the external environment. Furthermore, agility focuses on the interactions with customers, coordination of operational activities inside the firm and creating beneficial relationships with partners of the organization in the ecosystem (Sambamurthy *et al.*, 2003). Similar to this study, also Overby *et al.* (2006) defined agility as the firm's ability to detect environmental changes beforehand and stay ready for quick response.

Baskarada and Koronios (2018) defined organization agility as “the capacity for rapid, continuous and systematic evolutionary adaptation and entrepreneurial innovation directed at gaining and maintaining competitive advantage”. Based on the dynamic capabilities view, Baskarada and Koronios (2018) draw the boundaries for the agile organizations with five interactive capabilities as sensing, searching, seizing, shifting and shaping.

3.2.2. Main Approaches in the Literature

Academic literature regarding international studies can reach to a high number when the scope is chosen as the studies of enterprise agility. In contrast to this detailed investigation of the concept, it is hard to say that there is a specific consensus from a significant and unchanging perspective for assessing and analyzing an organization's agile capabilities. While many approaches exist, a common groundwork can be traced back to Sharifi and Zhang (1999), who laid out a set of criteria for explaining agility capabilities, agility drivers, and agility providers. According to this framework, an organization's ability to adapt to its exterior and internal environments depends on factors like responsiveness, competence, flexibility, and speed. According to Sambamurthy *et al.* (2003), a company needs three different kinds of agility: customer agility, partnership agility, and operational agility. The notion of "customer agility" describes a company's propensity to quickly adapt to changing market conditions by listening to and responding to feedback from its clients. Agility in partnering means being able to quickly respond to opportunities to leverage the expertise and resources of partners such as vendors, dealers, and manufacturers. Operational agility indicates the capacity to take advantage of novel chances in a timely, precise, and cost-effective manner. In their study on the topic, Overby *et al.* (2006) suggested a more simplified and basic perspective to the notion of organizational agility by breaking down the concept into its component parts, sensing and responding capability.

Sambamurthy *et al.* (2007) claimed that the concept of organizational agility deserves to be examined in two distinct subfactors: adaptive agility and entrepreneurial agility. Whereas entrepreneurial agility concentrates on an organization's ability to sense its surroundings and take preemptive action, adaptive agility refers to an organization's capacity for quick reaction and adapting ability to changes in its exterior setting. Sambamurthy *et al.* (2007) identified the two aforementioned primary factors for agility construct, along with six secondary level components. These secondary level factors are "proactiveness," "preemptiveness," "radical innovativeness," located under entrepreneurial agility and "reactiveness," and "resilience," and

"responsiveness" located under adaptive agility layers. In their further study, Sambamurthy *et al.* (2007) made major modifications in this construct (Lee *et al.*, 2015). Despite the fact that they retained four of the original six elements, they did make some adjustments, such as eliminating two main categorizations of agility, namely entrepreneurial and adaptive agility. Therefore, the second layer of agility types are relocated under one main variable labelled as organizational agility. Moreover, two dimensions named preemptiveness and resilience are no longer included in the agility construct.

This study is based on the study of Lee *et al.* (2015). Thus, the adaption and validation of the scale were carried out using the proactiveness, radicalness, responsiveness and adaptiveness framework, therefore, preemptiveness and resilience factors are not included in the model.

Goldman, Nagel and Preiss (1995) created a conceptual agility model which is composed of four strategic dimensions (as cited in Sherehiy *et al.*, 2007); 1) enriching the customer, 2) cooperating to enhance competitiveness, 3) organizing to master changes and 4) leveraging the impact of people and information. Goldman *et al.* pointed out the importance of customer satisfaction and sustaining competitive advantage for a firm to be agile with the internal effective coordination. In addition to that, the main factors for a company to develop agile characteristics are stated as people skills, knowledge and experience (as cited in Sherehiy *et al.*, 2007).

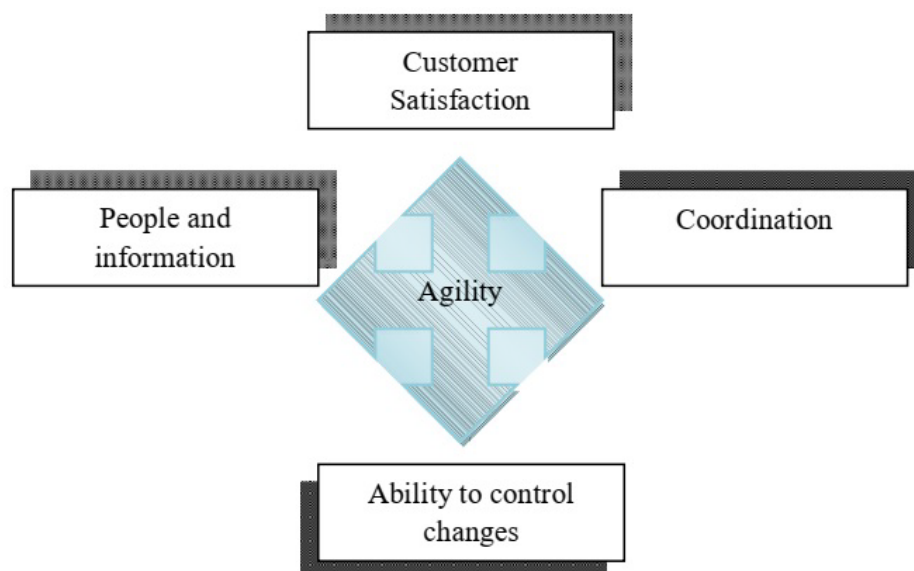


Figure 7 – Agility Conceptual Model

Source: Goldman *et al.*, 1995 (as cited in Kanani, 2016)

In their conceptual study, Yusuf *et al.*, (1999) proposed the capabilities an organization needs to be agile under 10 decision domains with 32 attributes. Referring to these attributes Yusuf *et al.* stated that “enterprise-wide integration of functions can lead to the significant achievement of a broad spectrum of competitive advantages.” The main domains Yusuf *et al.* (1999) argued were integration, competence, team building, technology awareness, quality, change, strategic partnerships with customers and suppliers, innovations for market demand, education for a learning organization, and employee satisfaction.

In the literature, most holistic and detailed agility framework was proposed by Sharifi and Zhang (1999) and this model is accepted and used for empirical studies by a number of researchers (as cited in Sherehiy *et al.*, 2007). Sharifi and Zhang argued about the main forces affecting the agility of organizations and classified these forces under three main components. The first component is called *agility drivers* representing the environmental changes forcing the organization to respond quickly and take a new stand. The second component is called *agility capabilities* representing the firms’ abilities which provide the necessary responsiveness, competency, flexibility and speed to be agile. The third component is called *agility providers* composed of the organization, technology, people and innovation. These providers are the necessary supporting activities to improve the agility capabilities of the firm.

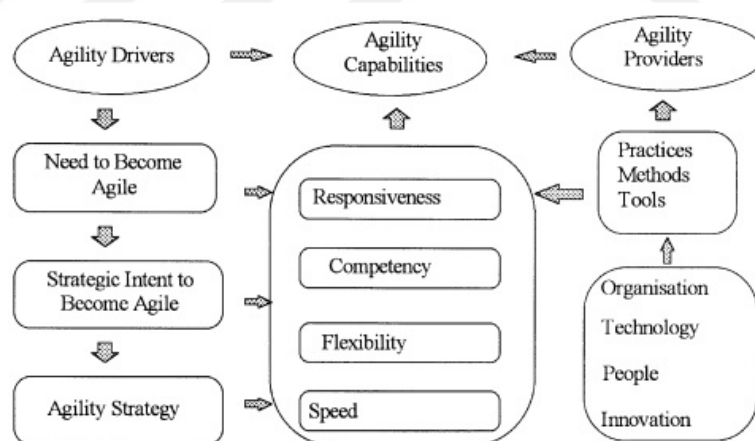


Figure 8 – Conceptual Model of Agility

Source: Sharifi and Zhang, 1999

Although a consensus on the definition of organizational agility is missing in the literature, it can be seen that the firms’ ability to sense environmental changes and responding to these changes with quickness and flexibility are the main components agreed mutually. In order to specify these characteristics table 5 is developed to present the different constructs with

their sub-factors, showing the different agility aspects that can be investigated within an organization's boundaries.

Table 5– Main Approaches of Agility in the Literature	
Author (Year)	Subfactors of the Approach
Youssef (1992)	• Quality • Speed • Cost
Sharifi and Zhang (1999)	• Responsiveness • Competency • Flexibility • Speed
Sambamurthy, Bharadwaj and Grover (2003)	• Customer agility • Partnering agility • Operational agility
Lee, Sambamurthy, Lim and Wei (2007)	• Entrepreneurial agility • Adaptive agility
Lu and Ramamurthy (2011)	• Market capitalizing agility • Operational adjustment agility
Lee, Sambamurthy, Lim and Wei (2015)	• Proactiveness • Radicalness • Responsiveness • Adaptiveness
Najrani (2016)	• Reactive agility • Proactive agility • Innovative agility
Panda and Rath (2016)	• Business process agility • Market-responsive agility
Teece, Peteraf and Leih (2016)	• Sensing • Seizing • Transforming/Pivoting

Al-Faouri and Al-Rfou (2017)	• Customer agility • Operation agility • Supply and distributive agility
Behrouz and Amirnejad (2017)	• Awareness • Flexibility • Effectiveness
Liang, Wang, Xue and Ge (2017)	• Sensing • Responding
Park, El Sawy and Fiss (2017)	• Sensing agility • Decision-making agility • Acting agility
Raeisi and Amirnejad (2017)	• Accountability • Competence • Flexibility • Speed
Ravichandran (2017)	• Customer responsiveness • Operational flexibility • Strategic flexibility
Saha, Gregar and Saha (2017)	• Speed • Adaptability • Flexibility • Capability • Execution
Baskarada and Koronios (2018)	• Sensing • Searching • Seizing • Shifting • Shaping
Kingles and Onuoha (2019)	• Alertness • Adaptive capability

3.2.3. Subfactors Used in the Study

Lee *et al.* (2015) were able to clarify the organizational agility design with four essential elements by utilizing the collaboration of many studies. These elements show how quickly an organization can move and adjust to variations in its surroundings. Being able to think ahead, advance quickly and efficiently, and react to new technologies, changes in the economy and shifts in the marketplace will help the firm stay prosperous in the immediate and moderate-term and be able to remain operational in the longer run.

3.2.3.1. Proactiveness

According to Miller and Friesen (1983), proactively acting enterprises transform their environment by constantly introducing new goods, technologies, management methods, and so on, while responsive organizations react to these trends and follow the trends of the proactive firms. Firms with smaller organizational sizes may benefit from reactive strategical approaches but throughout the organizational life cycle, expansion of the structure increase the necessity of acting proactively for decreasing the risks in the external environment (Ramanujam and Venkatraman, 1987). Lumpkin and Dess (1996) argue that first-movers can take advantage of market inequalities to make an extensive amount of revenue and get a head start on building brand recognition. Consequently, taking the lead through scanning for and seeking new chances allows the enterprise to act in a proactive manner. Companies with more vibrant value offers may be prone to take competent steps to take advantage of the possibilities in developing countries to capitalize on the markets with proactive choices (Sambamurthy *et al.*, 2007).

Najrani (2016) gives the following definition for taking proactive action: an organization that is able to act proactively perceives an emerging market pattern and changes its strategy to dramatically increase the profit whereas the sales force of the organization notices an unusual trend. According to Triaa *et al.* (2016), an organization's proactive response can be broken down into two components: organizational anticipation and innovation, which is the ambition to achieve novel things and the ability to do traditional tasks in new ways. These elements must work harmoniously with each component of the reactive response (Triaa *et al.*, 2016).

3.2.3.2. Radicalness

Lee *et al.* (2015) use the theories of Miller and Friesen (1983) and Zahra and Covin (1995) to describe radicalness as the capacity of an enterprise to execute radical strategy changes through implementing new business models for penetrating into new or developing markets. In earlier studies, "radicalness" component was labeled as "radical innovativeness" (Sambamurthy *et al.*, 2007). A radical or disruptive innovation transforms the manner in which an organization functions extensively, but an incremental or supporting innovation corresponds to the organization's current activities (Sambamurthy *et al.*, 2007).

Lee *et al.* (2015) utilized an instrument with a number of indicators for determining the degree of radical changes an enterprise can establish. The initial aspect focuses on how frequently the company engages in projects with elevated risks that have the potential to benefit satisfactorily. Secondarily, even if the results are uncertain, participating in business ventures is recognized as an indicator of radicalness since the organization seeks unguaranteed returns (Lee *et al.*, 2015). Moreover, the authors specify another crucial indicator of radical innovation as the fact that firms devote assets to profound shifts in order to influence market conditions and maintain their competitiveness (Lee *et al.*, 2015).

3.2.3.3. Responsiveness

The manifestation of organizational agility includes both reactive and proactive activities (Dove, 2005). Being proactive as an enterprise demonstrates the capability to take action prior to the occurrence of changes, whereas being responsive clarifies a rapid response to unanticipated environmental changes. Contrary to proactive behaviors that are primarily focused on innovation and position the corporation to a market-leading degree, reactionary movements are necessary in order to preserve sustainability and competitive advantage (Overby, 2006).

According to Lee *et al.* (2015), the responsiveness of an enterprise is a market-driven ability that focuses on spotting possible openings in the sector. One way in which businesses can stay ahead of the competition is by anticipating and adapting to shifts in consumer demand, market conditions, and external possibilities (regulatory updates, worldwide conditions). According to Akkaya *et al.* (2019), developments in both technological and social areas can

cause client preferences and requirements to shift over time. The need for successfully coping with these shifts, businesses need to be flexible and responsive.

3.2.3.4. Adaptiveness

In a more predictable environment, efficient enterprises may thrive. However, in a world where constant change is the standard, organizations have to remain adaptable. In the process of managing ordinary activities efficient characteristics may be satisfactory, but dramatical routine alterations require specialization in adaptiveness (Basadur *et al.*, 2014). Since environmental changes are unpredictably volatile, enterprises constantly need to be prepared to adapt rapidly to unforeseen changes. Organizations need an efficient flexible system to thrive in an unpredictable world (Niu and Li, 2022). Using the theoretical groundwork laid by Rindova and Kohra (2001) and Subramaniam and Youndt (2015), Lee *et al.* (2015) describe adaptability as the capacity to modify business models and maintain pace with developing best practices in the industry.

4. THEORETICAL BACKGROUND

In this section, the theoretical foundation for the research variables will be discussed. Beginning with the definition and discussion of multiple aspects of resource-based view, the importance of the relationship between organizational resources, organizational capabilities and competencies will be emphasized. Supported with the VRIO framework, the positive and negative sides of the theory will be indicated. In the second step, dynamic capabilities view will be discussed with multiple definitions and characteristics of the concept. Finally, the relationship of the variables with the theories will be discussed in the respective sections.

4.1. RESOURCE-BASED VIEW (RBV)

In the history of management theory, the resource-based view (RBV) has become one of the most prominent and mentioned theories with a main focus on explicating the internal origins of a company's sustained competitive advantage (SCA) (Kraaijenbrink, Spender and Groen, 2010). The RBV provides, at its most fundamental level, an understanding of the presence of equilibrium profits based on the heterogeneity of firms indicating that every company has different performance levels because of the attributes they possess (Lockett, Thompson and Morgenstern, 2009). RBV clearly seeks the internal origins of SCA and attempts to explain why enterprises in the same industry may exhibit varying levels of performance (Kraaijenbrink *et al.*, 2010). Heterogeneity among business organizations arises from their different control levels over the valuable resources within their boundaries.

Although there are numerous contributions to the RBV throughout the years, the work of Penrose (1959) formed the necessary foundation for the emergence of the theory. While inspecting the antecedents for the growth of the firms, she particularly pointed out the criticality of internal resources that the organizations possess under their control. In the following years, supportive studies are conducted such as the works of Andrews (1971), Wernerfelt (1984) and Barney (1986, 1991).

Barney (1991) defined the concept of resources as all properties, capabilities, activities of the organization, company characteristics, intelligence, knowledge, and so on held by an organization that allow the firm to devise and execute tactics that develop its efficient and effective operations. As implied in the definition, RBV takes its power from all internal

attributes an organization can have and expected to exploit these resources with maximum efficiency to support the SCA.

Hansen and Wernerfelt (1989) argued that firm-specific resources or intra-organizational factors are more vital in the explanation of the performance superiority of different organizations. In contrast with transaction cost economics which aims to explore the existence of the firms, RBV is a complementary approach to the external environment views such as the market-based approach which is based on industrial organization economics (Lockett *et al.*, 2009). In addition, Lockett *et al.* (2009) stated that with the employment of the resource as the main unit of analysis, RBV aims to draw the boundaries for the level that companies can sustain their positions with competitive advantages.

As indicated in different points of view in Table 6, RBV is a multi-faceted theory with multiple understandings of the resources and capabilities of the organizations, nevertheless, a major common standpoint is that the theory is mainly focused on the internal environment of the organizations in order to improve the ability to utilize the resources and capabilities with their full potential for benefit of the firm. In the studies existing in the literature, there are numerous studies trying to explain the crucial aspects of organizational resources and capabilities but the work of Barney (1991) is especially accepted as one of the most contributive since it creates a connection between theory and practice with the industrial application.

According to the RBV, companies are composed of physical, human and organizational resources and firm resources are assumed to be heterogeneous and immobile (Barney, 1991) In addition, Barney (1991) proposed a relationship that explains the connection between RBV and the environmental model of competitive advantage which he drew the boundaries of with the traditional environmental scanning approach of SWOT analysis. Strengths and weaknesses are located within the resource-based model and opportunities and threats are located within the environmental model of competitive advantage. Furthermore, Barney (1991) stated that all firm resources are not expected to have the power to sustain competitive advantage and created a framework to specify the attributes a resource should have to possess the potential to gain competitive advantage. With his VRIN framework approach, Barney emphasized that the resources of organizations should possess certain characteristics in four different levels; value, rareness, imperfect imitability and non-substitutability.

Table 6 – Main Contributions to the Resource-Based View	
Authors (Year)	Point of View
Penrose (1959)	Underlines the importance of an organization's internal resources. A company's growth is dependent on its resources and constrained by its management resources.
Andrews (1971)	Accentuates the criticality of the administration of internal resources
Lippman and Rumelt (1982)	Effective ties between uniqueness and causal ambiguity support SCA
Wernerfelt (1984)	Accepts the companies “as bundles of resources”
Rumelt (1984)	Similar to Wernerfelt (1984), strategic approach of the company is centered on the concept of “firms as resource bundles”
Barney (1986)	The dynamics of the components market govern enable companies to earn rents
Rumelt (1987)	“Firms as rent-seekers.” The significance of distinguishing rent-generating mechanisms
Rumelt (1987), Dierickx and Cool (1989)	Review of the concepts which create barriers for imitation such as causal ambiguity and isolation mechanisms.
Day and Wensley (1988), Aaker (1989), Grant (1991), Wernerfelt (1989)	Strategy formulation models centered on the firm resources based upon SCA
Prahalad and Hamel (1990)	Core competencies as company diversity and strategic drivers. Companies should leverage and utilize core competencies. Businesses should diversify into

	adjacent businesses that can utilize and augment their core skills
Hansen and Wernerfelt (1989), Rumelt (1991)	Empirical research that backs up the notion of resources and capabilities or organizational factors are more essential than industrial factors in explaining higher business performance.
Barney (1991)	VRIN framework arguing that the resources need to be valuable, rare, inimitable and non-substitutable for facilitating a SCA
Conner (1991)	A comparative approach to the RBV and other economics-based strategical approaches. Explanation of the resource-based theory's hypotheses and its ramifications for rent-earning methods
Peteraf (1993)	An integrating resource-based framework for SCA. Stating that the better performance for the companies is mainly based upon the rent earnings from the rare and valuable resources in the market.
Day (1994)	Capabilities model for obtaining SCA. Differentiates outside-in, spanning, and inside-out capabilities.
Collis and Montgomery (1995)	Managerially-oriented review of the RBV
Grant (1996)	A knowledge-based approach which claims the organizational knowledge is a strategical resource
Teece, Pisano, and Shuen (1997)	Development of dynamic-capabilities view

Source: Olavarrieta and Ellinger, 1997; Mahoney, 2004; Madhani, 2010.

4.1.1. Value

When resources allow organizations to either capitalize on market possibilities or protect themselves from market risks, those resources represent value. Thus, If a resource does not contribute to or add to the worth of the company in any way, then hanging onto it is not going to be beneficial to the company in any way (Madhani, 2010). Resources are only considered as high of value when they have can make a company develop or put strategical plans into action which increases its efficacy and efficiency. (Barney, 1991).

4.1.2. Rareness

Resources that are shared by multiple competitors in the market cannot grant an organization an SCA since they do not allow the organization to develop and implement a distinct business strategy compared with the rivals existing in the industry (Madhani, 2010). Thus, a common strategy won't result in any of the firms having an SCA if a lot of different companies have access to a highly valuable firm resource and are all capable of using it in the same way (Barney, 1991).

4.1.3. Imperfect Imitability

Rare and valuable firm resources can only be regarded as sources of SCA if companies without possession of those resources are also unable to acquire them (Barney, 1991). Madhani (2010) argued that there can be numerous barriers when trying to imitate a resource such as difficulties in the acquisition of the resource, uncertain relationships between the capabilities, and the complexity of the resource type.

4.1.4. Non-Substitutability

The final criterion for a firm resource to qualify as a source of SCA is the absence of strategically similar valuable resources that are either scarce or imitable. Moreover, two valuable business resources or resource bundles are regarded as strategically similar if they may be exploited independently to execute similar strategies. (Barney, 1991). On this basis, rivals

in the market should not be able to attain the same level of performance by substituting alternative resources (Madhani, 2010).

4.1.5. VRIO Framework

After a decade of the creation of the VRIN framework, Barney argued that heterogeneous and immobile resources are essential for developing a SCA, but merely possessing them is insufficient to preserve or even reap the rewards unless the business is designed to utilize them (Pang, 2021).

Thus, the parameters included in the VRIN framework are updated in the work of Barney and Hesterly (2010). Although, the value, rareness and inimitability concepts remained the same preserving their importance, framework gained the organization (O) parameter for indicating the importance of the organizational dynamics in order to benefit from the valuable, rare and inimitable resources that the organization possess. If VRIN resources are administered by untrained individuals who are unable to appraise their utility and/or benefits or make proper use of them (Katkalo, Pitelis and Teece, 2010) and also if the organization bears unsuitable conditions, conflicting cultural values and inefficient organization design, the firm will receive no gain.

4.1.6. Criticisms of the RBV

Although RBV is quite efficient in explaining the dynamics in the internal environment based upon the resources and capabilities of the firms, it still continues to receive criticisms on non-negligible level.

These limitations are classified under several main areas in the literature such as the vagueness of the terminology which refers to the definitional problems (Madhani, 2010), the tautological aspects of the assumptions that emerged from the theory which refers to the circular inconsistencies (Porter, 1994) and some methodological issues (Lockett *et al.*, 2001).

Vagueness of the terminology refers to the ambiguous definitions of the parameters such as resources, capabilities, assets, abilities and so on. There is no consensus among the scholars while drawing the boundaries and hierarchy between these concepts and they can use these

terms interchangeably. Furthermore, Kraaijenbrink *et al.* (2010) argues that the definitions made by the scholars for the term “resource” are overly inclusive. For example, Kraaijenbrink *et al.* (2010) point out that the definition made by Wernerfelt (1984) states that everything within the boundaries of an organizations which can be regarded as strengths or weaknesses represents a resource. Consequently, it can be clearly seen that definitions for resources cover almost all passive and active attributes within the firm, therefore, it can be interpreted as overly comprehensive.

One of the most important criticisms of the RBV is the methodological issues. The major downside of the RBV is its static nature while disregarding the external dynamics occurring in the market. While the change rate of the parameters in the industries increases rapidly, RBV loses its practicality.

In order to overcome these criticisms, RBV approach took major turns in the literature. Arguably the most crucial approach based on the RBV is dynamic capabilities which will be reviewed in the next sub-section.

4.2. DYNAMIC CAPABILITIES VIEW

When clarifying business successes and failures in a rapidly changing environment, RBV encounters conceptual difficulties since it disregards the depreciation of resources over time and focuses on firms while removing them from their industrial setting (Wojcik, 2015). Although assets can provide a certain level of capabilities, the resources approach does not specify the capabilities necessary for excellence beyond the VRIN criteria. A further deficiency of the resource-based perspective is its disregard for the renewal of a company's vital components when conditions demand it (Teece, 2018). Therefore, RBV appears inapplicable to elevated markets with swift and unforeseen shifts, instead dynamic capabilities can provide offer a more suitable theoretical justification (Eisenhardt and Martin, 2000).

Teece, Pisano, and Shuen (1997) define the perspective of dynamic capabilities as an organization's capacity to coordinate, develop, and reorganize both internal and external skills in response to constantly altering environmental conditions. Therefore, it is logical to say that the dynamic capabilities approach claims that a company's achievement is mainly determined by its capacity to respond to environmental shifts in order to maintain its value-creating prospects and, consequently, attain a SCA (Wojcik, 2015).

It can be clearly seen in Table 7 which covers the definitions existing in the literature that the dynamic capabilities view is a perspective rooted in the RBV. In contrast to the RBV, dynamic capabilities view examines the firm's resources, capabilities and competences in integration (Teece *et al.*, 1997; Zollo and Winter, 2002), in order to build higher-level capabilities for adapting rapidly changing environments.

In their respective studies, it is easy to identify that scholars postulate multiple relationship hierarchies between essential capabilities and dynamic capabilities of an organization which are represented in the Table 7 in detail.

Table 7 – Main Dynamic Capability Definitions in the Literature	
Authors	Definition
Teece, Pisano and Shuen, 1997, p. 516	Company's capacity to incorporate, develop, and reorganize both endogeneous and exogeneous capabilities in response to environments that change quickly.
Eisenhardt and Martin, 2000, p. 1107	The business's resource-using mechanisms, especially those that integrate, reconfigure, obtain, and utilize the resources, are intended to complement and even create changes in the industry. Thus, dynamic capabilities are the managerial and tactical practices that enable businesses to create new integrations in the resource allocation activities.
Zollo and Winter, 2002, p. 340	A dynamic capability is an acquired and consistent routine of collaborative process in order for a business to regularly create and adjust the activities of operation in an effective and efficient manner
Winter, 2003, p. 991	Essential or "zero-level" capabilities are those that allow a company to survive for a short period of time, in contrast to that, dynamic capabilities are those that enhance, improve, or generate these basic organizational capabilities.

Zahra, Sapienza and Davidsson, 2006, p. 918	The capabilities to reshape a company's assets and procedures as conceived and regarded suitable by the company's primary administrative agents
Helfat, Finkelstein, Mitchell and Peteraf, 2007, p. 4	The capability of a company to develop, expand, or alter its assets
Teece, 2007, p. 1319	Ability (1) to perceive and reshape possibilities and risks, (2) to exploit opportunities, (3) to stay ahead of competition by improving, integrating, safeguarding, and, if required, reorganizing the firm's intangible and tangible properties.
Chirico and Nordqvist, 2010, p. 499	Procedures intended to obtain, transfer, alter, and dispose of endogenous and exogenous sources
Lee, Lin, Kim and Shyr, 2011, p. 4197	Routines and practices of critical knowledge distribution that are used to solve problems, the primary improving entryway for which is learning and steady corporate government
Lim, Stratopoulos and Wirjanto, 2011, p. 50	The capability of the company to incorporate, develop, and modify information technology with managerial and organizational processes in to adapt to an environment of quickly shifting competition
Piening and Salge, 2015, p. 94	Process for businesses to innovate, establish and reproduce genuine operational procedures
Choi and Moon, 2015, p. 3	Corporate integration actions such as perceiving integration needs, unifying integration sources, and managing organizational capabilities and resources in an integrative setting
Simon, Bartle, Stockport, Smith, Klobas and Sohal, 2015, p. 916	The firm's capacity and practices to arrange its sources, allowing the company to adjust and develop

Wilhelm, Schlömer and Mourer, 2015, p. 328	A meta-routine intended to enhance a firm's running procedures
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Source: Adapted from the studies of Valente, 2021; Bleadly *et al.*, 2018.

4.3. THEORETICAL BACKGROUND OF THE TECHNOLOGICAL INNOVATION CAPABILITIES

In most studies, technological innovation capabilities are put in the context through the resource-based view and in some studies taken into consideration even further by Dynamic Capabilities Approach.

Resource-Based View of the firm indicates the “interplay” between an organization’s resources and capabilities, in order to achieve a core competency for the firm (Barney, 1991, as cited in Joo *et al.*, 2018).

Main assumption of the view states that “an organization’s resources are heterogeneous and not perfectly mobile” (Faridah and Yuserrie, 2016). In order to sustain the competitive advantage, resources which are high value, unique, inimitable and non-substitutable are critical (Barney, 1991, as cited in Faridah and Yuserrie). Faridah and Yuserrie (2016) summarize the argument of RBV and claim that the businesses are reliant upon their own physical and immaterial resources, as well as their competencies, in order to transform their impermanent competitive advantage into a sustaining competition edge and indicate the relationship between RBV and organizational capabilities as “the skills to organize resources”.

On the other hand, when put into categories, innovations created in the organization are separated into two main groups as technological and non-technological innovations (Damanpour, 1991). While technological innovations represent the new ideas transformed into products, processes and services, non-technological innovations focuses on the administrative improvements such as developments in procedures or policies.

While technological innovations require necessary capabilities, the action of using internal resources of the organization becomes crucial. To define further, Day (1994) explained capability as the network of bundled abilities and amassed knowledge, enacted via business procedures that enable companies to better handle their operations and maximize the

use of their assets. Furthermore, knowing that technological innovations require different organizational capabilities, it is rational to use RBV on the theoretical foundation.

Based on this, Dhewanto *et al.* (2012) state that the TIC is considered as one of the most important parameters to the organization in supporting competitive advantage from the perspective of RBV. They add that, criticality of the capability enables the firm to create much more valuable, rare, inimitable products and processes (Dhewanto *et al.*, 2012).

Although many researchers used RBV to study on technological innovation capabilities (Joo *et al.*, 2018; Faridah and Yuserrie, 2016; Huang, 2011), some researchers chose to take the concept further to explain the variable with dynamic capabilities view (Li-Ming *et al.*, 2017; Velasquez *et al.*, 2011).

Li-Ming *et al.* (2017) argue that the “core rigidity” of the RBV fails to explain the equation behind the performance differences of companies in the rapidly changing competitive environment. Furthermore, they add that in a market environment that is continuously shifting, continuous technological advancement will assist businesses in establishing and preserving their competitive advantage. In this regard, the capacity for innovative advancement in science and technology exhibits attributes of dynamic capabilities. In a similar aspect, Velasquez *et al.* (2011) state that building sustainable competitive advantages requires a creative company to cultivate dynamic capabilities that allow for the creation and implementation of innovative strategical steps.

4.4. THEORETICAL BACKGROUND OF THE ORGANIZATIONAL AGILITY

When considered from the point of view of a dynamic capability, the ever-shifting internal and external agility factors make the development of agility capabilities an absolute necessity. According to Matusik and Hill's (1998) definition of agility, competence is defined as identifying a particular group of activities that can be used to determine agility. Similarly, other scholars describe agility in terms of dynamic capabilities (Zhou & Wu, 2010) or meta-capabilities (Doz & Kosonen, 2010), while still other researchers approach agility as a strictly specified organizational capability for generating reaction variation and/or increasing response speed. (e.g., Adler *et al.*, 1999; Tallon & Pinsonneault, 2011).

While dynamic capabilities are discussed as the higher order of simple and essential organizational capabilities, agility creates a good example for it since it requires the harmony of multiple capabilities to work in a fast and efficient way.

According to Teece *et al.* (2016), dynamic capabilities are a grouping of processes, procedures, expertise, and entrepreneurship capabilities that are attributed to the management team. As a result, the perspective that takes dynamic capabilities into account is beneficial when applied to agility (Walter, 2021). Evans (1991) discusses agility as a capability while also implying that it is the capacity "to generate variety in order to respond to the unexpected and mutate into new forms in order to fit the contingency of the situation."

In a broader perspective, approximately 74% of the articles that are reviewed perceive agility as a capability, whereas only 59% describe agility as a capacity. Those individuals who included both perspectives in their description made up a sizeable percentage of only 22% of the population (Singh et al., 2013).

4.5. THEORETICAL FRAMEWORK OF THE STUDY

Since there is a significant gap regarding a study focusing on the effects of technological innovation capabilities on organizational agility, it is inconceivable to find a precise conceptual background of these two variables in the same equation.

Even though the lack of a study, it is still possible to create connections between the two concepts since there are studies concerning the relationship of innovation and agility.

In his study, Wendler (2013) reviewed the literature in detail and created a network of the concepts related to organizational agility. In this network, five main clusters are created which are organizational culture, workforce, customer, organizational abilities and technology. In his cognitive mapping, Wendler (2013) specified the connections of the concepts such as technology, innovation, flexibility, quickness, responsiveness, proactivity, adaptivity, resiliency and integration which proves the conceptual relationship of the subfactors of agility and organizational capabilities in an enterprise.

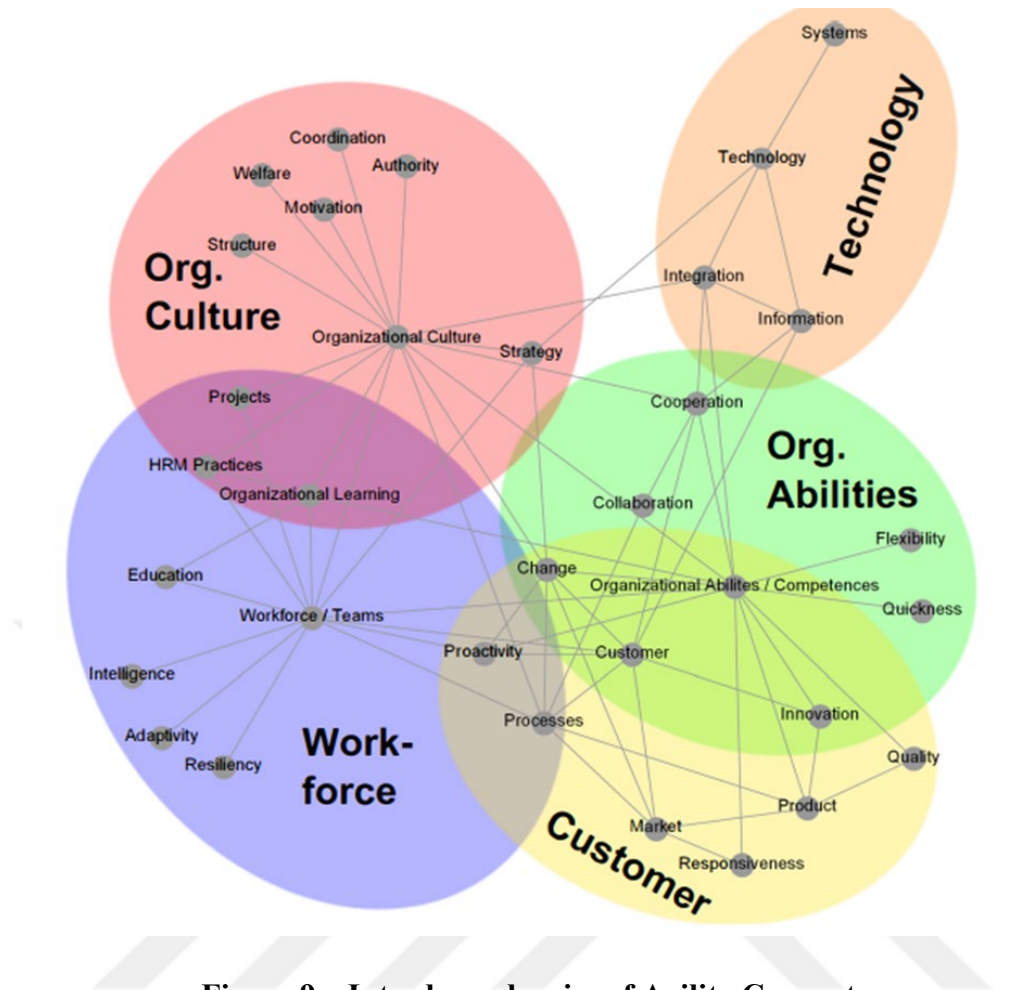


Figure 9 – Interdependencies of Agility Concepts

Source: Wendler (2013)

In order to understand the relationship between technological innovation and organizational agility, Sharifi and Zhang's conceptual agility model must be examined concerning the agility drivers, providers and agility capabilities.

While it can be seen that under agility providers, technology and innovation are accepted as the factors which improve the organizations' agile behavior, in an update of the conceptual model by Tseng and Lin (2011), it can be seen that the agility drivers are composed of markets, social factors and technological innovations.

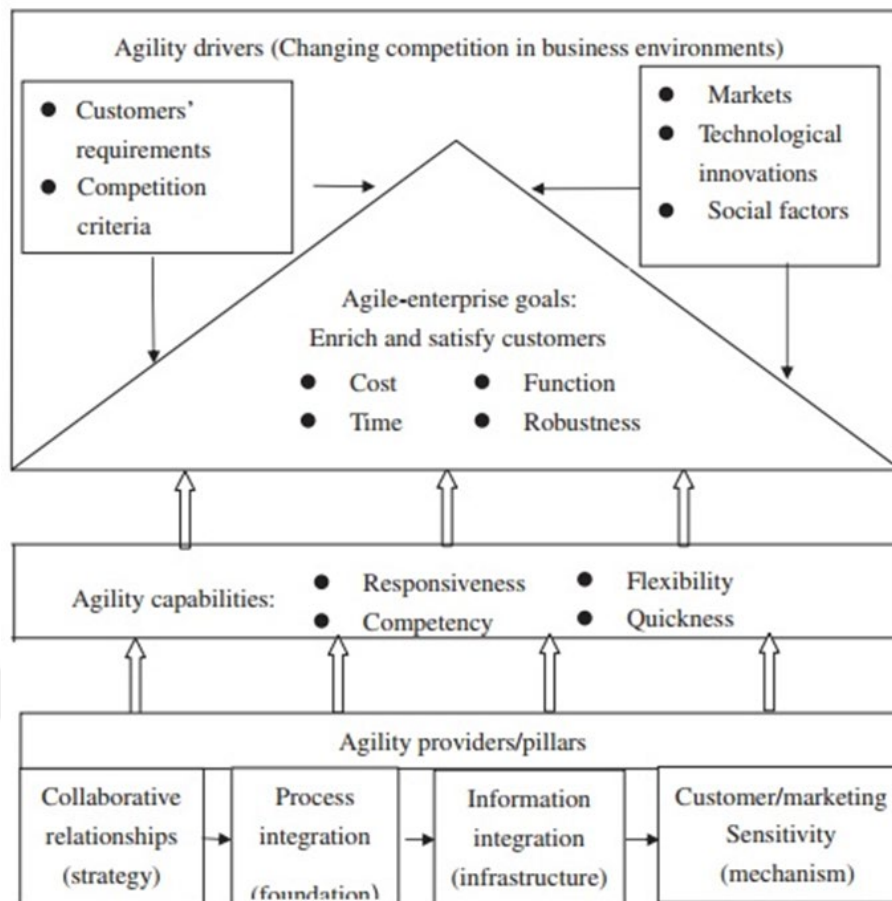


Figure 10 – Conceptual Model of an Agile Enterprise

Source: Tseng and Lin (2011)

In addition to that, Tseng and Lin (2011) state that “the deployment and linkage of agility drivers, capabilities and providers, and their transformation into a competitive edge are critical for enhancing agility.” Since agility drivers are accepted as the pressures which force the organizations to be agile, firms need to be fast and responsive to customer requirements, competition criteria, changes in the market, social factors and technological innovations for staying competitive.

5. METHODOLOGY

In this section, the methodological information used in the research and their results will be provided in detail. This information is represented under several main subsections. The aim of the study represents the research model that the study is focused into and the questions it is supposed to answer. The scope of the research represents detailed information about the research sample. Survey instruments section represents the tools of measurement used to assess the variables in the model. And lastly, research findings show the results of multiple statistical analyses in the order of descriptive analyses, exploratory factor analyses, confirmatory factor analyses, convergent and discriminant validity analyses and SEM results regarding the two structural equation models aiming to answer the research hypotheses.

5.1. AIM OF THE STUDY

As indicated in the literature review section, there are high number of studies present focusing on the organizational agility ability and technological innovation capabilities of companies. But no study is existent focusing on both variables in the same research model to explore the relationship. This study fills the gap in the field by identifying the effects of technological innovation capabilities on organizations' proactive, responsive and adaptive abilities.

Since the velocity of change increases exponentially in recent years, it is certain for organizations to be able to take actions not just reactively but also proactively. Rapid developments in technology increase the innovation levels for the new products and this also results in the invalidation of various product ranges. Therefore, the necessity for companies to be continuously agile and aware of their environment is no longer a reality that can be compromised.

In addition to the emphasis on the importance of organizational agility, the innovative capabilities of an organization are also accepted as crucial factors which boost organizations to obtain and sustain their competitive advantages. While these capabilities are indispensable for a firm's survival, they are also vital for a firm to be technologically innovative in its business field. Consequently, the relationship between these two crucial variables is interpreted to be

possessing utmost importance to identify the capabilities which have relatively higher effects on organizational agility as well as the lower or no effect ones.

5.2. SCOPE OF THE RESEARCH

The sample of the research is among a mass of well-established firms in order to be able to measure multiple organizational capabilities in detail as well as the agility levels. Due to the fact that the variable of technological innovation capabilities encompasses a number of organizational capability sub-factors, some of which are quite specific, it is intended to draw the majority of the research sample from organizations that have achieved a certain level of organizational maturity. To achieve this, the list of firms operating in Turkey as research and development centers is used. This list is formed by the Ministry of Industry and Commerce of Turkey (2021) consisting of approximately 1257 firms (the list is being updated throughout the year which can result in minor number changes).

Table 8 – Research and Development Centers in Turkey	
Number of Operating R&D Centers	1.257
Total Personnel Number (Including Support Personnel)	75.610
Bachelor's Degree	45.388
Master's Degree	13.812
Ph.D. Degree and above	1.233
Number of Projects (Completed)	52.458
Number of Projects (In Progress)	14.715
Patent Count	31.955
Registration	10.087
Application	21.868
Foreign/Foreign Partnered Firm Number Operating as R&D Centers	193

R&D centers are distinct business organizations of capital corporations having their legal or business headquarters in Turkey and established to conduct the company's research and development and innovation activities with adequate R&D expertise and capability (Ministry of Industry and Commerce, 2021). Due to the importance of organizational-level information, employees who will respond to the questionnaire are selected from among general managers, vice presidents, department heads or their assistants, or first-line managers.

In addition to the organizational-level positions of the sample, multiple informants (at least 2 respondents from each organization) are accessed to gather the answers in order to reduce the bias in the data set.

5.3. DATA COLLECTION

Participants were contacted by phone using their company's details found on the ministry's website. A number of them decided to complete the questionnaire over the phone, while others chose to do so online. At the completion of the data gathering procedure, 320 forms were acquired, 208 of which were answered via telephone and 112 were filled out on the online survey website. The participants are informed of the purpose of the study, and the confidentiality of their responses has been assured.

5.4. RESEARCH MODEL OF THE STUDY

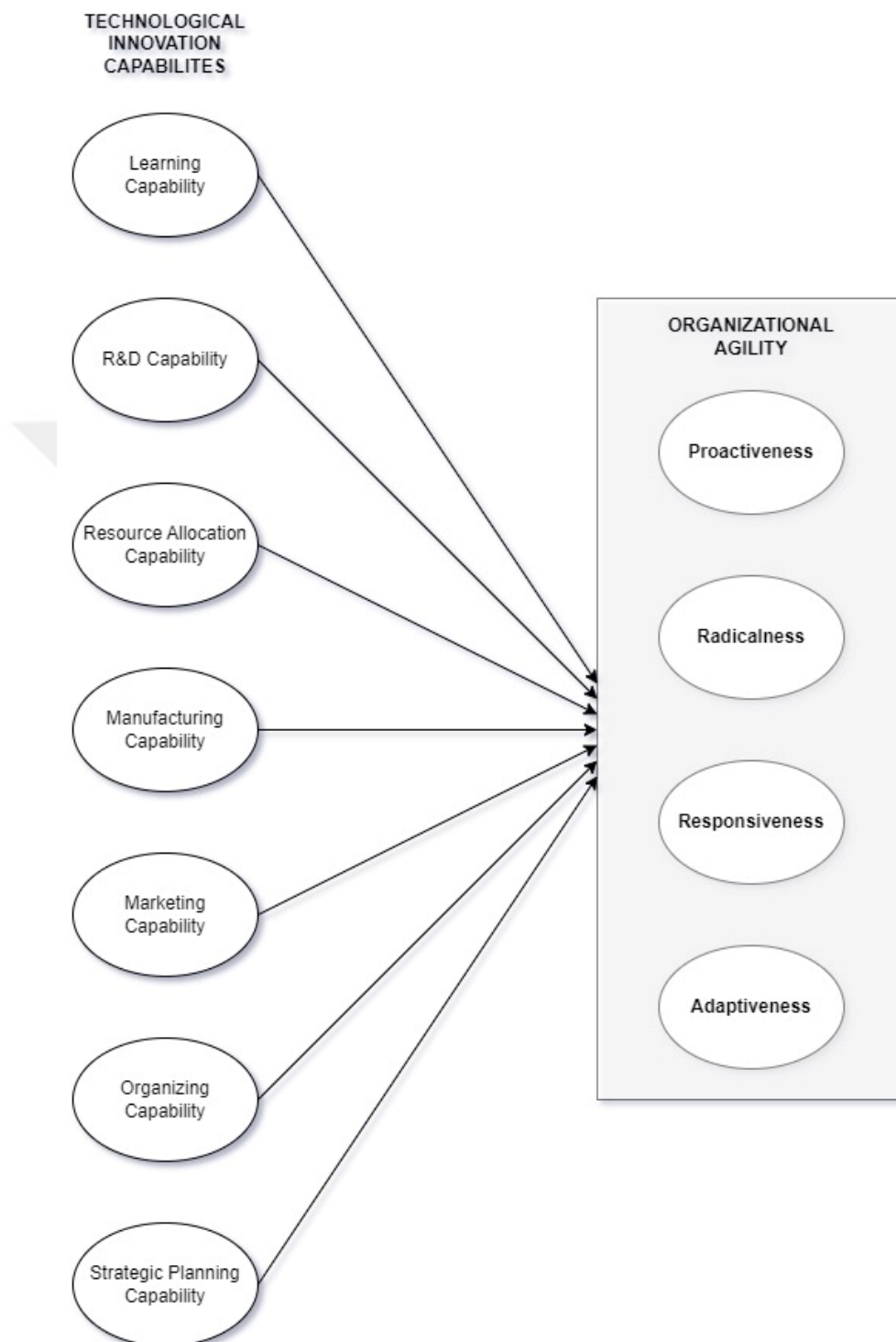


Figure 11 – Research Model of the Study

As indicated in the theoretical framework of the study, the research model is drawn according to the specified constructs and the main relationship combinations are drawn according to the hypotheses. The markings for the sub-hypotheses are indicated in the path analyses of the structural equation model.

5.5. SURVEY INSTRUMENTS

For the research, quantitative data is collected via multiple instruments in form of a survey. The survey method has been one of the essential data gathering techniques in the field of social sciences for years. The first section of the survey is prepared to measure the technological innovation capabilities; second section of the survey is prepared to measure the organizational agility, and lastly, in third section of the survey is prepared for the measurement of demographical information of the respondents.

The scale used in this study for measuring the capability levels that are supporting technological innovation capacity of the companies is based on the work of Yam *et al.* (2004). The questionnaire is divided into seven main dimensions that are representing the essential capabilities of an organization supporting the company's technological innovation capacity. These factors and the item counts are as follows; learning capability (9 items), R&D capability (17 items), resource allocation capability (9 items), manufacturing capability (9 items), marketing capability (9 items), organizing capability (7 items) and strategic planning capability (6 items). Appendix B indicates all of the statements included in the questionnaire and the item labels that are used in the statistical analyses.

While there are various instruments with single or multi-factored constructs, it cannot be true to say that there is a consensus between researchers to measure the organizational agility level of an organization. The instrument used in this study which belongs to the study of Lee *et al.* (2015) is also a multi-dimensional scale with 12-items. There are four dimensions to identify the aspects of agility such as proactiveness, radicalness, responsiveness and adaptiveness. Each of the factors is measured with 3 items.

In the research 5-point Likert scale is used with options such as (1) Strongly disagree; (2) Disagree; (3) Neither agree nor disagree; (4) Agree; (5) Strongly agree for analyzing the importance of the statement to the respondents.

5.6. RESEARCH FINDINGS

At the end of the data collection stage, various statistical analyses are executed to transform the data into information and interpret the output. During this process, software such as SPSS 26 and AMOS 26 is used to execute the appropriate analyses.

In the first step, based on the survey's demographic questions, frequency distributions are utilized to evaluate the sample. In the second step, exploratory factor analyses are executed for each variable distinctively to detect the item distributions and formation of new factors. With the removal of the items with low or close cross-loading values, the formation of new or modified factors is determined. Subsequently, Cronbach's alpha values are calculated for proving the reliability of all dimensions.

In the second step, confirmatory factor analyses are conducted to see if the fitness value for each variable and its subfactors is satisfactory. Following the CFA, convergent validity and discriminant validity tests are executed to check if the AVE and CR values for every factor are above the necessary thresholds.

In the last step, structural equation modelling method is applied to check the relationship values between the independent and dependent variables and test the hypotheses of the study.

5.6.1. Descriptive Statistics

In this subsection, the statistics of the demographical information will be presented regarding the distribution frequencies of age, gender, education level, working years, number of employees, and sector types.

5.6.1.1. Age Distribution

Sample of the study is composed of 320 respondents distributed among the age groups of 18 to 25 (4.4%), 26 to 35 (41.3), 36 to 45 (39.1%), 46 to 55 (14.4%) and 55 and above (0.9%).

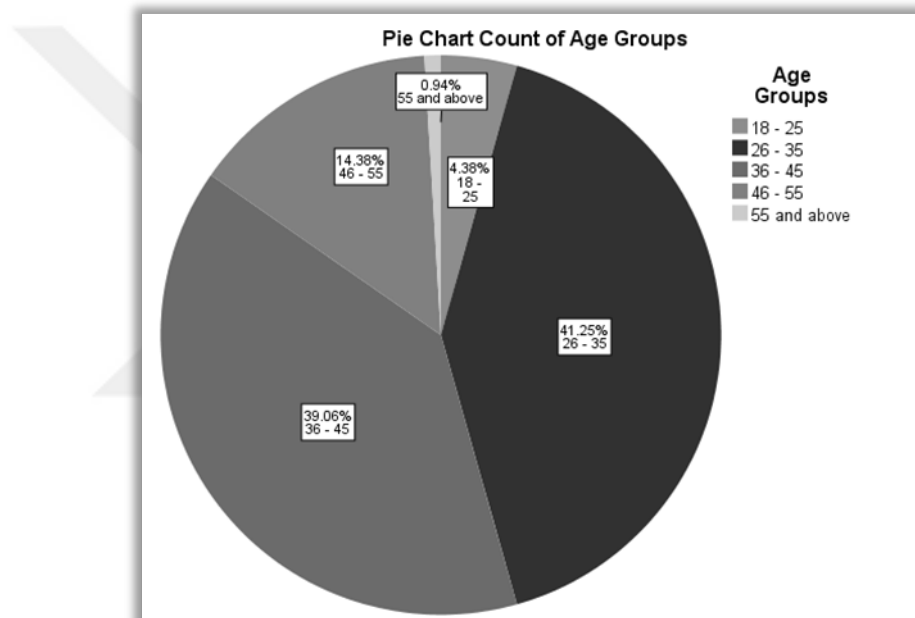


Figure 12 – Pie Chart of Age Distribution

It can be clearly seen that the majority of the sample is between the ages of 26 and 45. Since the sample is especially chosen among the managerial level employees, it is quite natural to be distributed with these frequencies.

Table 9 – Age Groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18 - 25	14	4.4	4.4	4.4
	26 - 35	132	41.3	41.3	45.6
	36 - 45	125	39.1	39.1	84.7
	46 - 55	46	14.4	14.4	99.1
	55 and above	3	.9	.9	100.0
	Total	320	100.0	100.0	

5.6.1.2. Gender Distribution

As can be seen in the table 10, sample is composed of 60.6% males and 39.4% females with frequencies of 126 and 194 respectively.

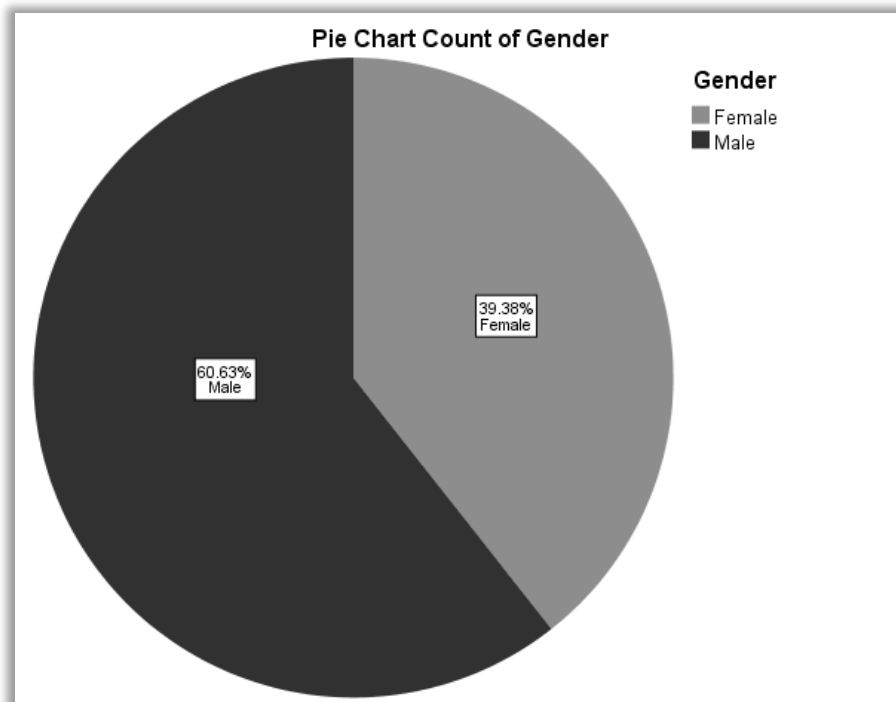


Figure 13 – Pie Chart of Gender Distribution

Table 10 – Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	126	39.4	39.4	39.4
	Male	194	60.6	60.6	100.0
	Total	320	100.0	100.0	

5.6.1.3. Education Level Distribution

Education levels of the respondents are grouped under 5 different levels as high school degree, associate degree, bachelor's degree, master's degree and doctoral degree.

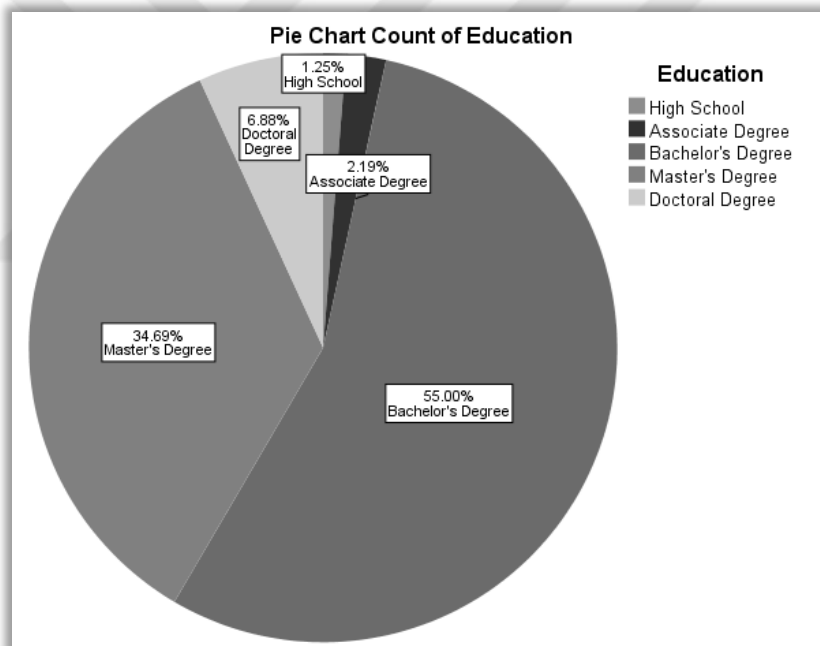


Figure 14 – Pie Chart of Education Levels

The percentages of the groups are presented in table 11. It shows that the majority of the sample possesses a bachelor's degree (55%) which is closely followed by a master's degree (34.7%).

Table 11 – Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High School	4	1.3	1.3	1.3
	Associate Degree	7	2.2	2.2	3.4
	Bachelor's Degree	176	55.0	55.0	58.4
	Master's Degree	111	34.7	34.7	93.1
	Doctoral Degree	22	6.9	6.9	100.0
	Total	320	100.0	100.0	

5.6.1.4. Distribution of Working Years

Frequencies of the working years of the respondents in their respective organizations are presented under multiple groups such as 1 to 3 years (36.3%), 4 to 6 years (27.5%), 7 to 10 years (13.8%), 11 to 15 years (10.6%), 16 to 20 (7.2%) and lastly 21 years and above (4.7%).

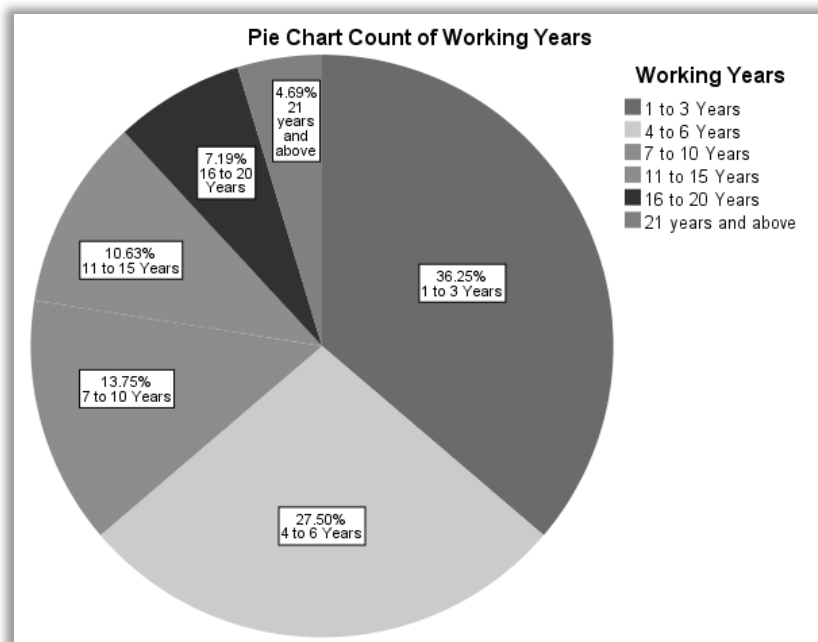
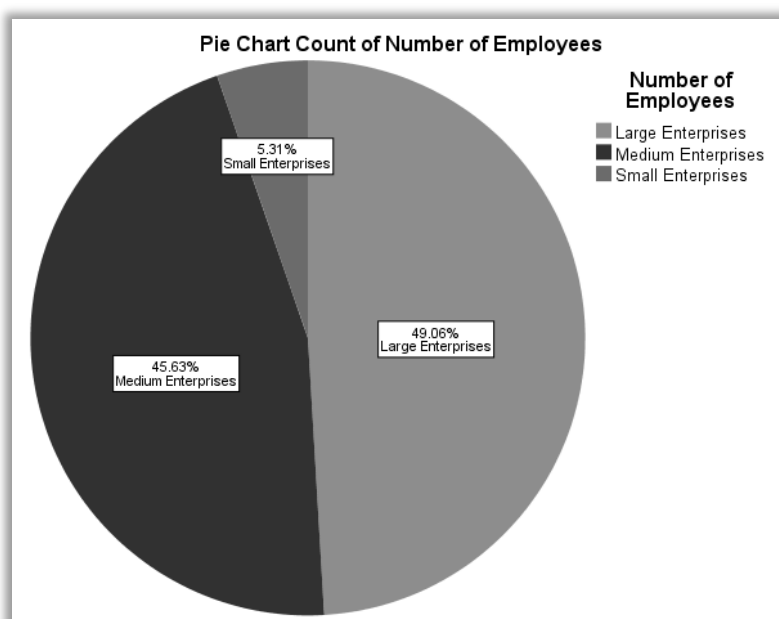
**Figure 15 – Pie Chart of Working Years**

Table 12 – Working Years

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 to 3 Years	116	36.3	36.3	36.3
	4 to 6 Years	88	27.5	27.5	86.3
	7 to 10 Years	44	13.8	13.8	100.0
	11 to 15 Years	34	10.6	10.6	46.9
	16 to 20 Years	23	7.2	7.2	54.1
	21 years and above	15	4.7	4.7	58.8
	Total	320	100.0	100.0	

5.6.1.5. Distribution of Number of Employees

Enterprises are grouped under the number of employees they have in their organizations. OECD (2023) states that the most common employee number limitations used for the size classifications are 1 to 9 employees for micro-enterprises, 10 to 49 employees for small enterprises, 50 to 249 employees for medium enterprises, and 250 and above employees for large enterprises.

**Figure 16 – Pie Chart of Number of Employees**

As can be seen in Table 13, the sample does not include any micro-enterprises since all of the answers to the “number of employees” question are above 10. The distribution of the organization sizes are as follows; 17 small enterprises (5.3%), 146 medium enterprises (45.6%) and 157 large enterprises (49.1%).

It is seen that nearly half of the organizations evaluated in the study are large organizations and above 94% of the organizations are medium or large organizations.

Table 13 – Number of Employees

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Large Enterprises (Over 250 Employees)	157	49.1	49.1	49.1
	Medium Enterprises (50 – 249 Employees)	146	45.6	45.6	94.7
	Small Enterprises (10 – 49 Employees)	17	5.3	5.3	100.0
	Total	320	100.0	100.0	

5.6.1.6. Distribution of Sector Types

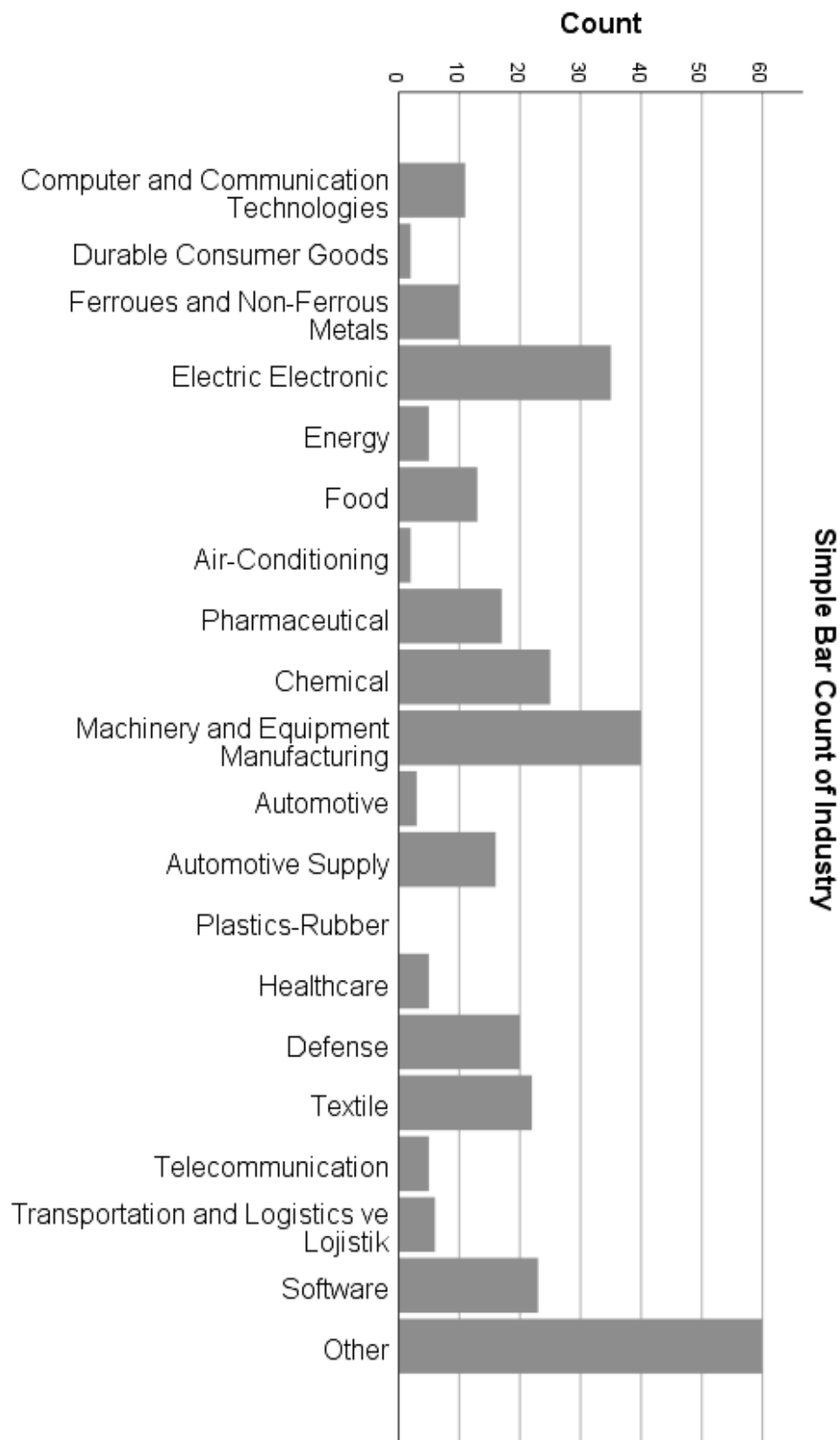


Figure 17 – Bar Chart for the Distribution of Industries

Table 14 – Distribution of the Sectors

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Computer and Communication Technologies	11	3.4	3.4	3.4
	Durable Consumer Goods	2	.6	.6	4.1
	Ferrous and Non-Ferrous Metals	10	3.1	3.1	7.2
	Electric-Electronics	35	10.9	10.9	18.1
	Energy	5	1.6	1.6	19.7
	Food	13	4.1	4.1	23.8
	Air-Conditioning	2	.6	.6	24.4
	Pharmaceutical	17	5.3	5.3	29.7
	Chemical	25	7.8	7.8	37.5
	Machinery and Equipment Manufacturing	40	12.5	12.5	50.0
	Automotive	3	.9	.9	50.9
	Automotive Supply	16	5.0	5.0	55.9
	Healthcare	5	1.6	1.6	57.5
	Defense	20	6.3	6.3	63.7
	Textile	22	6.9	6.9	70.6
	Telecommunication	5	1.6	1.6	72.2
	Transportation and Logistics	6	1.9	1.9	74.1
	Software	23	7.2	7.2	81.3
	Other	60	18.8	18.8	100.0
	Total	320	100.0	100.0	

As can be seen in Table 14, the information related to the industries show that machinery and equipment has 12.5%, electric-electronics has 10.9% and chemical has 7.8%. Since,

industry types listed in the ministry website has quite a high number, some of the companies preferred to choose the other option which has a 18.8%.

5.6.2. Exploratory Factor Analyses and Reliability Analyses

In this section, exploratory factor analyses are executed for the technological innovation capabilities and organizational agility in order to detect the relationship patterns between the indicators of the scale.

Exploratory factor analysis (EFA) is a multivariate statistical method used to create and validate psychological theories and assessments (Watkins, 2018). Hair *et al.* (2019) state that the “primary purpose is to define the underlying structure among the variables in the analysis”. Pattern identification is necessary in order to evaluate the accuracy and intelligibility of the scale.

Prior to factor analysis, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity were conducted. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy "quantifies the level of intercorrelations between variables and the suitability of factor analysis" (Hair *et al.*, 1998, p. 99). KMO indicator can obtain values between 0 and 1 and the value intervals are labeled as "0.90 is as outstanding," "0.80 is as very good," "0.70 is as average," "0.60 is as tolerable," "0.50 is as poor," and "below 0.50 is unacceptable." If the index is at least 0.50, it indicates that the requirements have been met prior to factor analysis, while the significance level of Bartlett's Test of Sphericity is below 0.05 threshold.

5.6.2.1. EFA and Reliability Analysis for Technological Innovation Capabilities

Technological innovation capabilities scale, which belongs to the study of Yam *et al.* (2004), is a multi-dimensional instrument formed to collect in-depth information about the organization-level capabilities of an enterprise. The instrument is composed of 66-items under seven factors to measure the technological innovation capabilities of an organization from different aspects and abilities a firm possesses. Although a high number of items in the scale grants the researcher a detailed information input, similar and highly related items create numerous times of EFA repetitions for the exclusion of items which has low factor loading values or cross-loadings.

In this study, data concerning technological innovation capabilities show results of well above the minimum requirements to be accepted as suitable for exploratory factor analysis since $KMO = 0.946$, $\chi^2 = 8056.276$ and $p=0.000$.

Table 15 – Results of EFA and Reliability Analyses for Technological Innovation Capabilities					
Factor Name	Label	Items	Factor Loadings	Variance Explained (%)	Reliability (Cronbach's α)
MANUFACTURING CAPABILITY	MNC1	“Contribution of the manufacturing department during the initial phase of the innovation process.”	.615	48.761	.917
	MNC2	“Ability to comply with the requests of R&D.”	.695		
	MNC3	“Overall technical capability of equipment.”	.629		
	MNC4	“Effectiveness of applications of the state of the art manufacturing methods.”	.614		
	MNC5	“Capability of manufacturing personnel.”	.703		
	MNC6	“Extent which continuous improvement of the manufacturing system is in place.”	.726		
	MNC7	“Level of importance attached to overall quality control.”	.664		
	RDC10	“Quality and speed of feedback from manufacturing to design and engineering.”	.550		
MARKETING CAPABILITY	MKC1	“Relationship management with major customers.”	.583	4.514	.920
	MKC2	“Knowledge of different market segments.”	.741		
	MKC3	“Effectiveness of the marketing intelligence system.”	.739		
	MKC4	“Effectiveness of marketing information dissemination.”	.740		
	MKC5	“Distribution efficiency.”	.705		
	MKC6	“Sales-force efficiency.”	.692		
HR PLANNING CAPABILITY	RAC1	“Attaching importance to human resource.”	.726	3.998	.906
	RAC2	“Programming human resource in phases.”	.719		

	RDC1	“Mechanisms to encourage and reward inventiveness and creativity.”	.643		
	RDC4	“Clear project targets, project phase standards and project managing regulations.”	.610		
	LC8	“Cultivating learning readiness and investing on learning.”	.620		
	SPC4	“Goal clarity.”	.511		
	SPC5	“Availability of a clear plan—a road map with measurable milestones.”	.541		
R&D INVESTMENT CAPABILITY	RAC4	“Steady capital supplement in innovation activity.”	.719	3.890	.874
	RAC5	“Flexibility and diversity of capital origins.”	.673		
	RD14	“Level of R&D investment in new products.”	.720		
	RD15	“Level of R&D investment in new processes.”	.723		
TECHNOLOGY LEARNING CAPABILITY	LC1	“Systematically monitoring technology development trends.”	.703	3.341	.773
	LC2	“Capacity to assess technologies relevant to firm’s business strategy.”	.702		
	LC5	“Understanding firm’s core competencies and matching technological capabilities to market needs.”	.643		
ORGANIZING CAPABILITY	OC1	“Flexibility in adjusting the organization structure.”	.756	3.144	.772
	OC2	“Autonomy of sub-units.”	.725		
	OC3	“Ability to handle multiple innovation projects in parallel.”	.549		
EXPERIENTIAL LEARNING CAPABILITY	L6	“Learning the lessons of experiences.”	.732	3.117	.832
	L7	“Passing lessons learned across boundaries and time.”	.780		
		Total Variance (%)		70.764	
		KMO		.946	
		Bartlett’s Test of Sphericity Chi-square		8056.276	

	df	528
	p-value	.000

Table 15 shows the final exploratory factor analysis for the independent variable technological innovation capabilities. The items excluded from the analysis can be found in Appendix C at the end of the document.

Exploratory factor analysis is finalized with 33 items distributed under 7 factors which are labelled as “manufacturing capability”, “marketing capability”, “HR planning capability”, “R&D Investment capability”, “technology learning capability”, “organizing capability” and “experiential learning capability” according to the common grounds between the items. Total of 7 factors show a total variance above 70%. In addition, Cronbach’s alpha values for the factor reliability are distributed above the 0.70 threshold as manufacturing capability with 0.917, marketing capability with 0.920, HR planning capability with 0.906, R&D investment capability with 0.874, technology learning capability with 0.773, organizing capability with 0.772 and lastly, experiential learning capability with 0.832.

5.6.2.2. EFA and Reliability Analysis for Organizational Agility

In this study, data concerning organizational agility shows values above the minimum requirements to be accepted as suitable for exploratory factor analysis since $KMO = 0.904$ and $\chi^2 = 3305.510$, $p=0.000$. Distributions of the items show a precise pattern when compared to the theoretical model. Total variance explained by four factors is above 85% and all factor loadings are above 0.50 threshold. Cronbach’s alpha values necessary for the reliability tests represent the results of 0.921 for responsiveness, 0.863 for radicalness, 0.903 for proactiveness and 0.972 for adaptiveness which prove a high level of reliability for each dimension. Because of a high cross-loading value between two distinct factors, ADP3 item excluded from the model.

Table 16 – Results of EFA and Reliability Analyses for Organizational Agility

Factor Name	Label	Items	Factor Loadings	Variance Explained (%)	Reliability (Cronbach's α)
RESPONSIVENESS	RES1	“Rapidly react to emerging opportunities in customer needs”	.785	64.927	.921
	RES2	“Rapidly react to emerging opportunities in markets.”	.803		
	RES3	“Rapidly react to emerging environmental opportunities (e.g., new regulations, globalization).”	.761		
RADICALNESS	RAD1	“Seek high-risk projects with chances of high return.”	.770	8.787	.863
	RAD2	“Support business experimentation despite uncertain returns.”	.846		
	RAD3	“Commit resources to radical changes that can potentially transform markets and competition.”	.767		
PROACTIVENESS	PRO1	“Anticipate new business opportunities.”	.812	6.521	.903
	PRO2	“Seek new business opportunities.”	.831		
	PRO3	“Seek novel approaches to future market needs.”	.671		
ADAPTIVENESS	ADP1	“Adapt existing business models.”	.831	5.721	.972
	ADP2	“Adapt existing business processes.”	.846		
		Total Variance (%)		85.956	
		KMO		.904	
		Bartlett's Test of Sphericity Chi-square		3305.510	
		df		55	
		p-value		.000	

5.6.3. Confirmatory Factor Analyses

In structural equation modelling, confirmatory factor analysis has been usually used to measure the validation of the construct (Jöreskog, 1969). Furthermore, Hair *et al.* (2019) argues that the confirmatory factor analysis (CFA) is a method for determining the extent to which a predetermined measurement theory that is created from assessed indicators and factors corresponds to reality as demonstrated by data. Moreover, in contrast to EFA, before findings can be calculated, the investigator must define both the range of factors that exist for a collection of variables and which factor each variable will load on. As a result, the statistical method fails to link indicators to the factors (Hair *et al.*, 2019).

When the limits used in most of the statistical analyzes are examined, it is observed that the thresholds change slightly when the sample size is larger than 250. Thus, the limitations will be interpreted accordingly. While technological innovation capabilities variable includes 33 observed variables, organizational agility variable possess only 12 indicators which creates slightly different criteria for the interpretation of CFA results for each variable.

Table 17 – Criteria for Different Fit Indices Demonstrating Goodness-of-Fit						
No. of Stat. vars. (m)	N < 250			N > 250		
	m ≤ 12	12 < m < 30	m ≥ 30	m < 12	12 < m < 30	m ≥ 30
χ^2	Insignificant p-values expected	Significant p-values even with good fit	Significant p-values expected	Insignificant p-values even with good fit	Significant p-values expected	Significant p-values expected
CFI or TLI	.99 or better	.97 or better	Above .93	.96 or better	Above .94	Above .92
RNI	May not diagnose misspecification well	.97 or better	Above .93	.96 or better, not used with N > 1,000	Above .94, not used with N > 1,000	Above .92, not used with N > 1,000
SRMR	Biased upward, use other indices	.08 or less (with CFI of .95 or higher)	Less than .09 (with CFI above .93)	Biased upward; use other indices	.08 or less (with CFI above .94)	.08 or less (with CFI above .92)
RMSEA	Values < .08 with CFI of = .99 or higher	Values < .08 with CFI of .97 or higher	Values < .08 with CFI above .93	Values < .07 with CFI of .96 or higher	Values < .07 with CFI of .94 or higher	Values < .07 with CFI of .92 or higher
<i>Note: m = number of observed variables; N applies to number of observations per group when applying CFA to multiple groups at the same time.</i>						

Source: Hair *et al.* (2019)

5.6.3.1. Results of Confirmatory Factor Analysis for Technological Innovation Capabilities

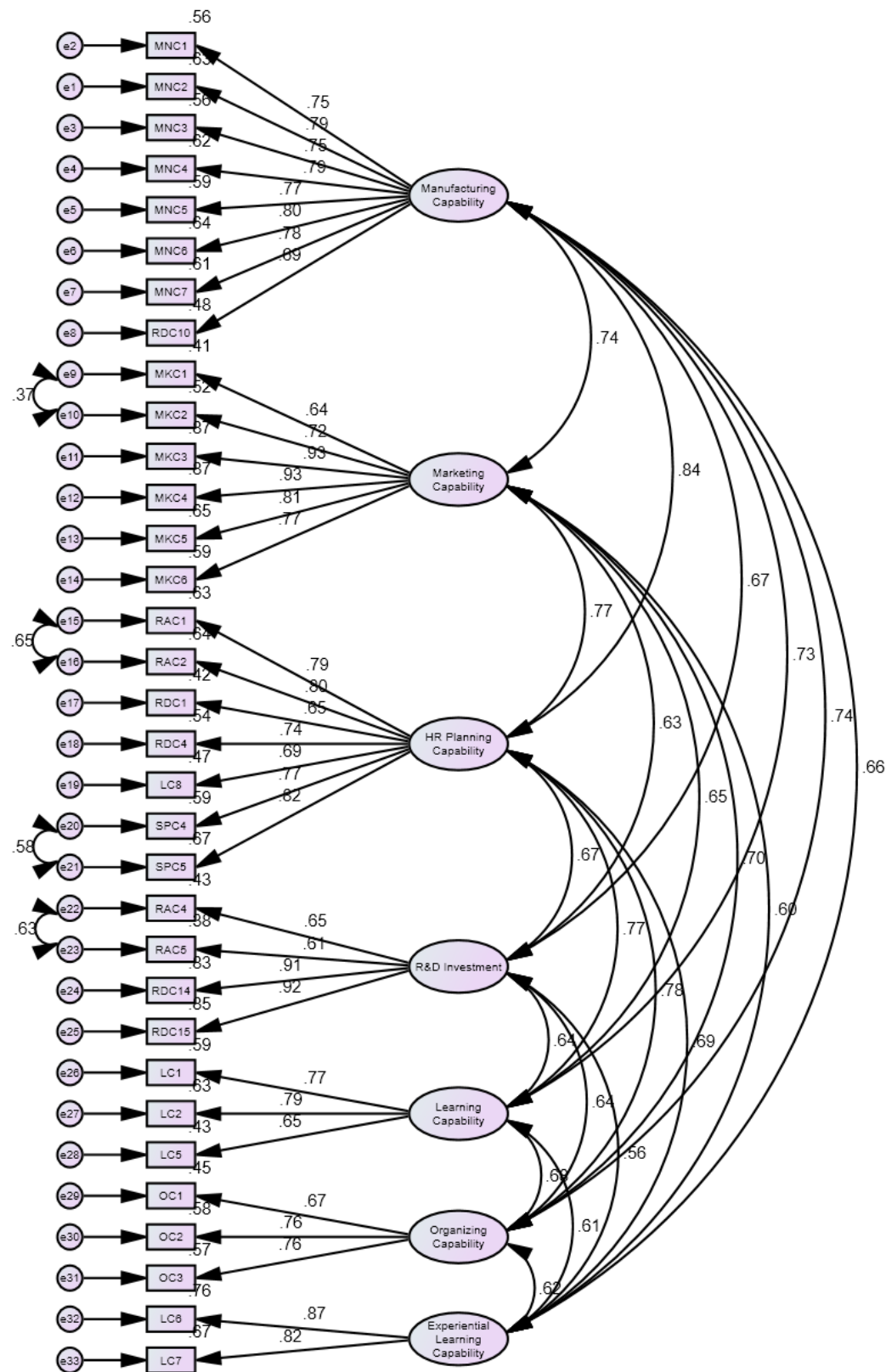


Figure 18 – Amos Map for CFA of Technological Innovation Capabilities

According to the results of the CFA for technological innovation capabilities, the values demonstrated by the model show arguable results. While RMSEA and SRMR values are within the necessary ranges, CFI and TLI values are below the required thresholds. In situations like this, modification indices should be checked. For each feasible connection that is not evaluated in a model, a modification index is computed (Hair *et al.* 2019). Furthermore, Since modification indices are estimated for all non-estimated parameters, they can be utilized for detecting erroneous term correlations as well as correlational links across constructs that may not be originally defined in the CFA model (Hair *et al.*, 2019). In order to correct these highly correlated error terms, a covariance path should be drawn to connect the items. In this model, error terms of e9 and e10, e15 and e16, e20 and e21, and lastly, e22 and e23 are connected to improve the goodness-of-fit.

As can be seen in the “after modification” table, TLI and CFI values passed the 0.92 threshold which shows that the fitness level of the technological innovation capabilities construct can be regarded as satisfactory indicating that it can be used in a structural equation analysis.

Understandardized and standardized factor loading values are also represented in the Table 20 along with the critical ratios of the regression weights.

Table 18 – Fit Statistics of Measurement Model Before Modification

χ^2	df	χ^2/df	TLI	RMSEA	CFI	SRMR
1441,319*	474	3,041	.863	.080	.877	.0527

Note: * $p < .05$

Table 19 – Fit Statistics of Measurement Model After Modification

χ^2	df	χ^2/df	TLI	RMSEA	CFI	SRMR
984,050*	470	2,094	.926	.059	.934	.0595

Note: * $p < .05$

Table 20 – Parameter Estimates and Cronbach’s Alpha Coefficients of Technological Innovation Capabilities

Item	Unstandardized	C.R.	Standardized
Manufacturing Capability			
MNC1	1,109	12,512	0,746
MNC2	1,081	13,263	0,794
MNC3	0,985	12,586	0,751
MNC4	1,148	13,129	0,785
MNC5	1,009	12,894	0,770
MNC6	1,084	13,363	0,800
MNC7	1,033	13,096	0,783
RDC10	1.000		0,693
Marketing Capability			
MKC1	0,643	11,885	0,642
MKC2	0,844	13,559	0,719
MKC3	1,226	18,616	0,932
MKC4	1,225	18,627	0,933
MKC5	0,918	15,569	0,808
MKC6	1,000		0,765
HR Planning Capability			
LC8	0,764	13,181	0,685
RAC1	0,993	15,970	0,795
RAC2	1,048	16,069	0,798
RDC1	0,932	12,231	0,645
RDC4	0,898	14,450	0,736
SPC4	0,926	23,848	0,771
SPC5	1,000	13,181	0,815
R&D Investment Capability			
RAC4	0,794	13,637	0,653
RAC5	0,798	12,497	0,614
RDC14	0,927	23,740	0,912
RDC15	1.000		0,925
Technology Learning Capability			

LC1	1,238	11,073	0,771
LC2	1,031	11,278	0,794
LC5	1.000		0,654
Organizing Capability			
OC1	1,122	11,148	0,672
OC2	1,22	12,534	0,762
OC3	1.000		0,757
Experiential Learning Capability			
LC6	0,965	14,107	0,873
LC7	1,000		0,820

5.6.3.2. Results of Confirmatory Factor Analysis for Organizational Agility

According to the results of the CFA for organizational agility, the values shown by the model are above the necessary thresholds. When compared with the limitations given by the study of Hair *et al.* (2019), it can be easily seen that the RMSEA value is below 0.07 and SRMR value is below 0.08. Additionally, TLI and CFI values are above 0.960. Therefore, the construct is verified to be used in the structural equation analysis.

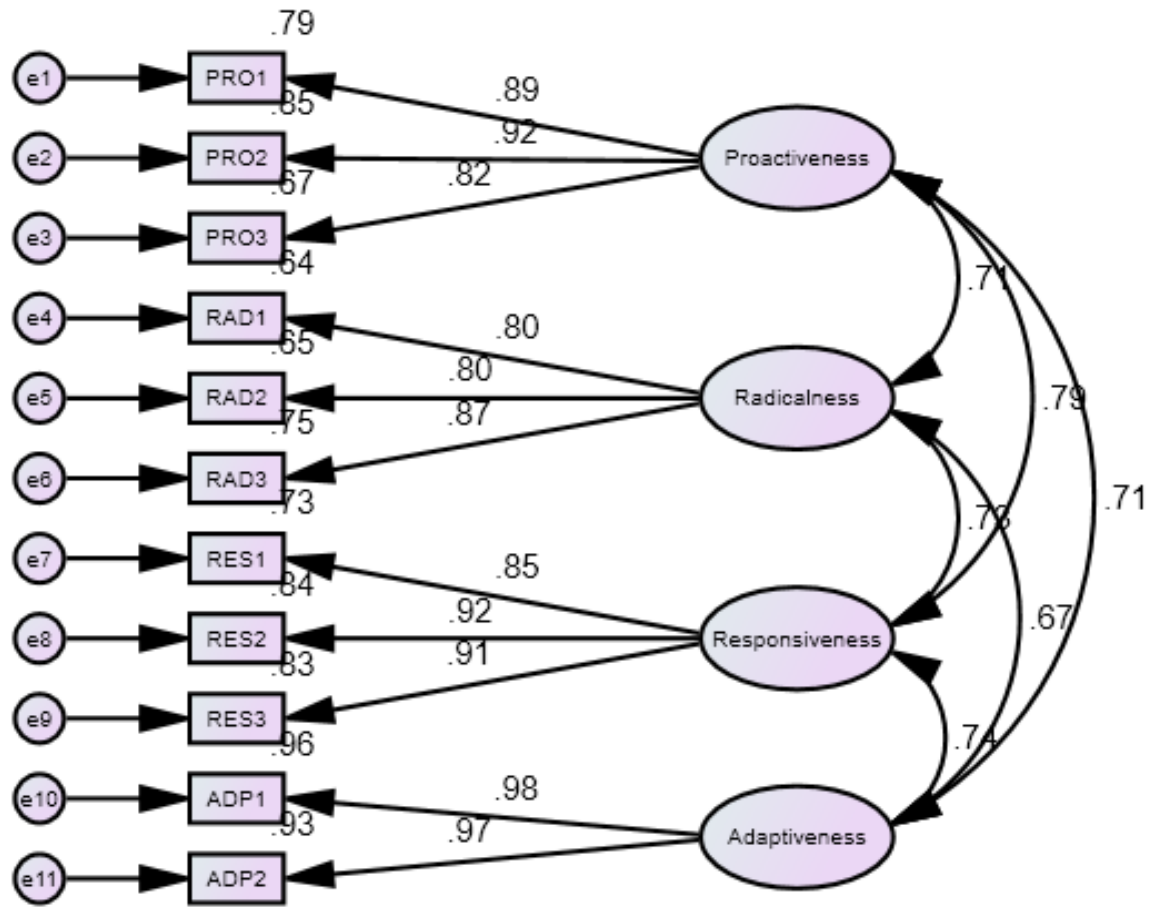


Figure 19 – Amos Map for CFA of Organizational Agility

Table 21 – Fit Statistics of Measurement Model

χ^2	df	χ^2/df	TLI	RMSEA	CFI	GFI	SRMR
78.984*	38	2.079	.982	.058	.988	.959	.0301

Note: * p < .05

Table 22 – Parameter Estimates and Cronbach’s Alpha Coefficients of Proactiveness, Radicalness, Responsiveness and Adaptiveness

Item	Unstandardized	C.R.	Standardized
Proactiveness			
Pro1	1.151	19.314	.887
Pro2	1.088	20.359	.923
Pro3	1.000		.820
Radicalness			
Rad1	.929	16.436	.799
Rad2	.897	16.583	.804
Rad3	1.000		.865
Responsiveness			
Res1	.873	21.927	.852
Res2	1.002	25.822	.917
Res3	1.000		.909
Adaptiveness			
Adpt1	.993	40.724	.981
Adpt2	1.000		.965

5.6.4. Convergent and Discriminant Validity Analyses

Campbell and Fiske (1959) claimed that the validity of a construct can be assessed in two separate stages. The first stage is the convergent validity which represents the level of confidence that proves a component is assessed successfully by the indicators. The second stage is is discriminant validity which represents the level that the items of the different components are unrelated sufficiently. The criteria of Fornell-Larcker (1981) is the common ground that is being used to measure the level of the variance shared between the model’s latent variables. In accordance with this method, the convergent validity can be verified through the Average Variance Extracted (AVE) and Composite Reliability (CR) values (Alarcon, Sanchez and Olavide, 2015).

According to Alarcon *et al.* (2015) “AVE measures the level of variance captured by a construct versus the level due to measurement error, values above 0.7 are considered very good, whereas, the level of 0.5 is acceptable. CR is a less biased estimate of reliability than Chonbach’s Alpha, the acceptable value of CR is 0.7 and above.”

Additionally, according to the Fornell-Larcker (1981) verification methodology, discriminant validity can be calculated by the comparison of the values of construct’s variance capture and shared variance with other constructs. Therefore, correlation between the constructs should be lower than the square root of the average variance extracted for respective constructs.

5.6.4.1. Convergent and Discriminant Validity Analyses for Technological Innovation Capabilities

As table 23 indicates the composite reliability (CR) value for each dimension of the technological innovation capabilities construct is above the 0.70 threshold. Furthermore, AVE values are above the lower limit of 0.50. Thus, it is safe to say that the dimensions are proved to be reliable.

Moreover, the square roots of the AVE values are calculated and compared with the correlation values between the dimensions. According to the results, it can be seen that the marketing capability, R&D investment and experiential learning capability dimensions possess correlation values lower than the square root of the respective AVE values which justifies the discriminant validity of the factors. On the contrary, dimensions of manufacturing capability, HR planning capability, technology learning capability and organizing capability show some levels of strong correlations. The reason for that can be explained with the lack of rigid boundaries between the capabilities dispersed throughout the organization. In addition, another reason can be stated as the lack of data to claim that the scale used in the research is free of defects.

Table 23 – Results of Convergent and Discriminant Validity Analyses

Latent	CR	AVE	MNC	MRKC	HRPC	RNDIC	TLC	OC	ELC
MNC	0,919	0,586	0,766						
MRKC	0,917	0,651	0,744	0,807					
HRPC	0,900	0,565	0,840	0,768	0,752				
RNDC	0,864	0,622	0,671	0,632	0,673	0,789			
TLC	0,785	0,551	0,727	0,650	0,774	0,641	0,742		
OC	0,775	0,535	0,738	0,701	0,776	0,642	0,680	0,731	
ELC	0,836	0,718	0,657	0,596	0,690	0,556	0,607	0,616	0,847

Note: MNC: manufacturing capability; MRKC: marketing capability; HRPC: HR planning capability; RNDC: R&D investment capability; TLC: technology learning capability; OC: organizing capability; ELC: experiential learning capability; CR: Composite reliability; AVE: average variance extracted

5.6.4.2. Convergent and Discriminant Validity Analyses for Organizational Agility

As table 24 demonstrates the composite reliability (CR) value for each dimension of the organizational agility construct is above the 0.70 threshold. In parallel, AVE values are above the lower limit of 0.50. Therefore, convergent reliability requisities are met. Moreover, the square roots of the AVE values are calculated and compared with the correlation values between the dimensions. Square root of AVE value for each component is above the correlation values between the dimension which justifies the discriminant validity of the construct.

Table 24 – Results of Convergent and Discriminant Validity Analyses

Latent	CR	AVE	PRO	RAD	RES	ADPT
PRO	.909	.770	.877			
RAD	.862	.677	.707	.823		
RES	.921	.797	.793	.729	.893	
ADPT	.972	.973	.713	.666	.745	.986

Note: PRO: proactiveness; RAD: radicalness; RES: responsiveness; ADPT: adaptiveness; CR: Composite reliability; AVE: average variance extracted

5.6.5. Modified Research Model

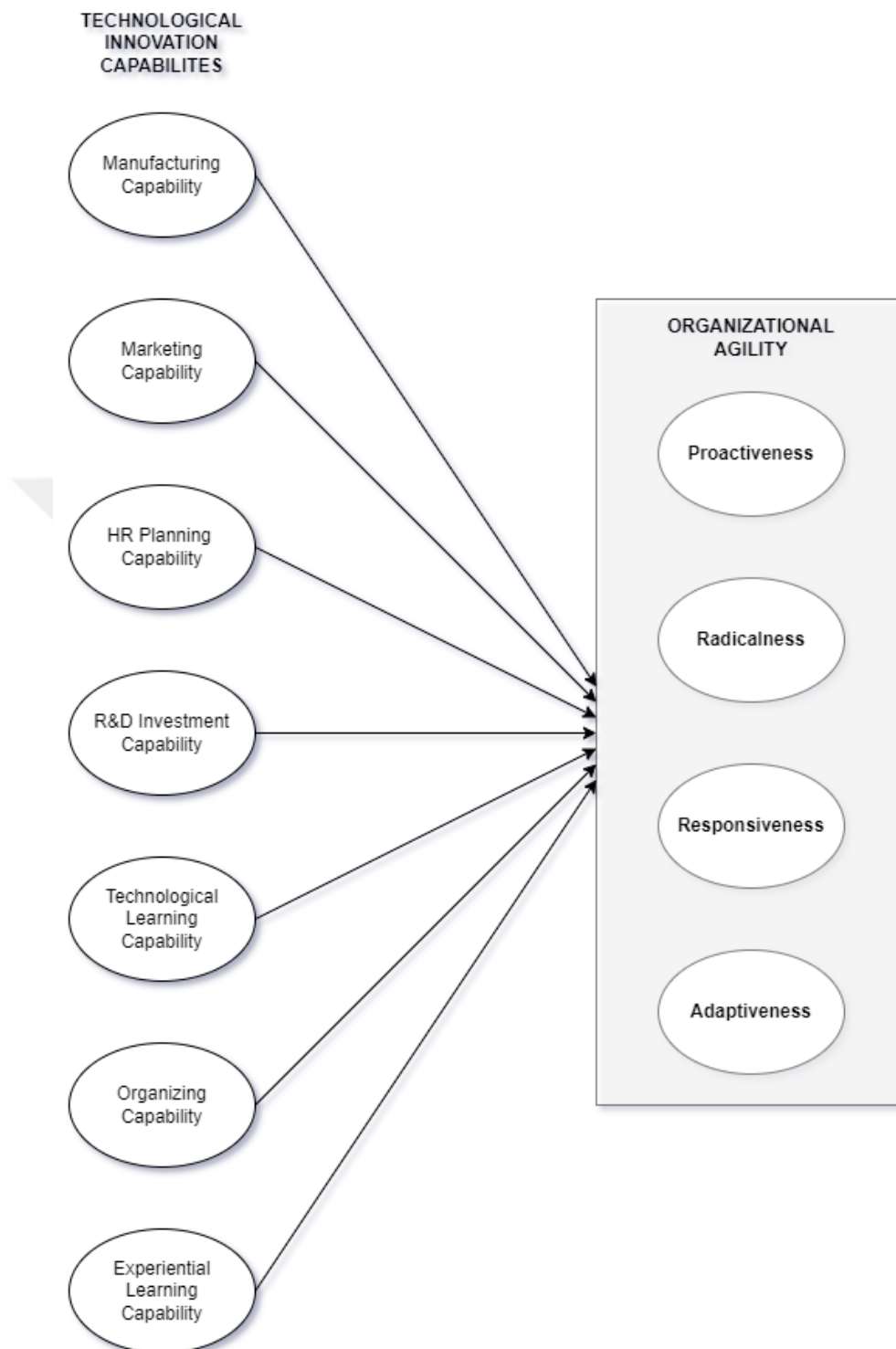


Figure 20 – Modified Research Model

5.6.6. Research Hypotheses

With the modification of the independent variable's dimensions, the main research hypotheses of the study are formed as follows:

- h₁:** Manufacturing capability affects organizational agility in positive direction.
- h₂:** Marketing capability affects organizational agility in positive direction.
- h₃:** HR planning capability affects organizational agility in positive direction.
- h₄:** R&D investment capability affects organizational agility in positive direction.
- h₅:** Technology learning capability affects organizational agility in positive direction.
- h₆:** Organizing capability affects organizational agility in positive direction.
- h₇:** Experiential learning capability affects organizational agility in positive direction.

Subfactor hypotheses focusing on organizational agility dimensions are as follows:

- h_{1a}:** Manufacturing capability affects proactiveness in positive direction.
- h_{1b}:** Manufacturing capability affects radicalness in positive direction.
- h_{1c}:** Manufacturing capability affects responsiveness in positive direction.
- h_{1d}:** Manufacturing capability affects adaptiveness in positive direction.
- h_{2a}:** Marketing capability affects proactiveness in positive direction.
- h_{2b}:** Marketing capability affects radicalness in positive direction.
- h_{2c}:** Marketing capability affects responsiveness in positive direction.
- h_{2d}:** Marketing capability affects adaptiveness in positive direction.

h3a: HR planning capability affects proactiveness in positive direction.

h3b: HR planning capability affects radicalness in positive direction.

h3c: HR planning capability affects responsiveness in positive direction.

h3d: HR planning capability affects adaptiveness in positive direction.

h4a: R&D investment capability affects proactiveness in positive direction.

h4b: R&D investment capability affects radicalness in positive direction.

h4c: R&D investment capability affects responsiveness in positive direction.

h4d: R&D investment capability affects adaptiveness in positive direction.

h5a: Technology learning capability affects proactiveness in positive direction.

h5b: Technology learning capability affects radicalness in positive direction.

h5c: Technology learning capability affects responsiveness in positive direction.

h5d: Technology learning capability affects adaptiveness in positive direction.

h6a: Organizing capability affects proactiveness in positive direction.

h6b: Organizing capability affects radicalness in positive direction.

h6c: Organizing capability affects responsiveness in positive direction.

h6d: Organizing capability affects adaptiveness in positive direction.

h7a: Experiential learning capability affects proactiveness in positive direction.

h7b: Experiential learning capability affects radicalness in positive direction.

h7c: Experiential learning capability affects responsiveness in positive direction.

h7d: Experiential learning capability affects adaptiveness in positive direction.

5.6.7. Structural Equation Modelling

Hair *et al.* (2019) define the structural equation modelling as a “multivariate technique combining aspects of factor analysis and multiple regression that enables the researcher to simultaneously examine a series of interrelated dependence relationships among the measured variables and latent constructs (variates), as well as between several latent constructs”. Furthermore, Ullman and Bentler emphasize that the “SEM is also referred to as causal modeling, causal analysis, simultaneous equation modeling, analysis of covariance structures, path analysis, or CFA. The latter two are actually special types of SEM”.

5.6.7.1. SEM Results for the Research Model I

In the research model I for this study, capabilities of technological innovation are mapped as exogenous variables and the organizational agility is located as the endogenous variable. The one-way direction arrows indicate the path analyses for the hypothesis testing. Two-way arrows represent the covariance relationships between the exogenous components. Also, the values indicated on the path arrows represent the standardized regression weights for the relationships.

Fit statistics for the structural equation analysis are shown in the Table 25. CFI and TLI values are above 0.920 threshold and RMSEA and SRMR values are below 0.06 which is accepted as a good fit. These values show that the structural model proposed in this study is acceptable.

Furthermore, table for unstandardized estimates indicate the p-values for hypotheses for seven path analyses. Values represent that the manufacturing capability, marketing capability, R&D investment capability, technology learning capability and organizing capability indicate a significant and positive effect on organizational agility.

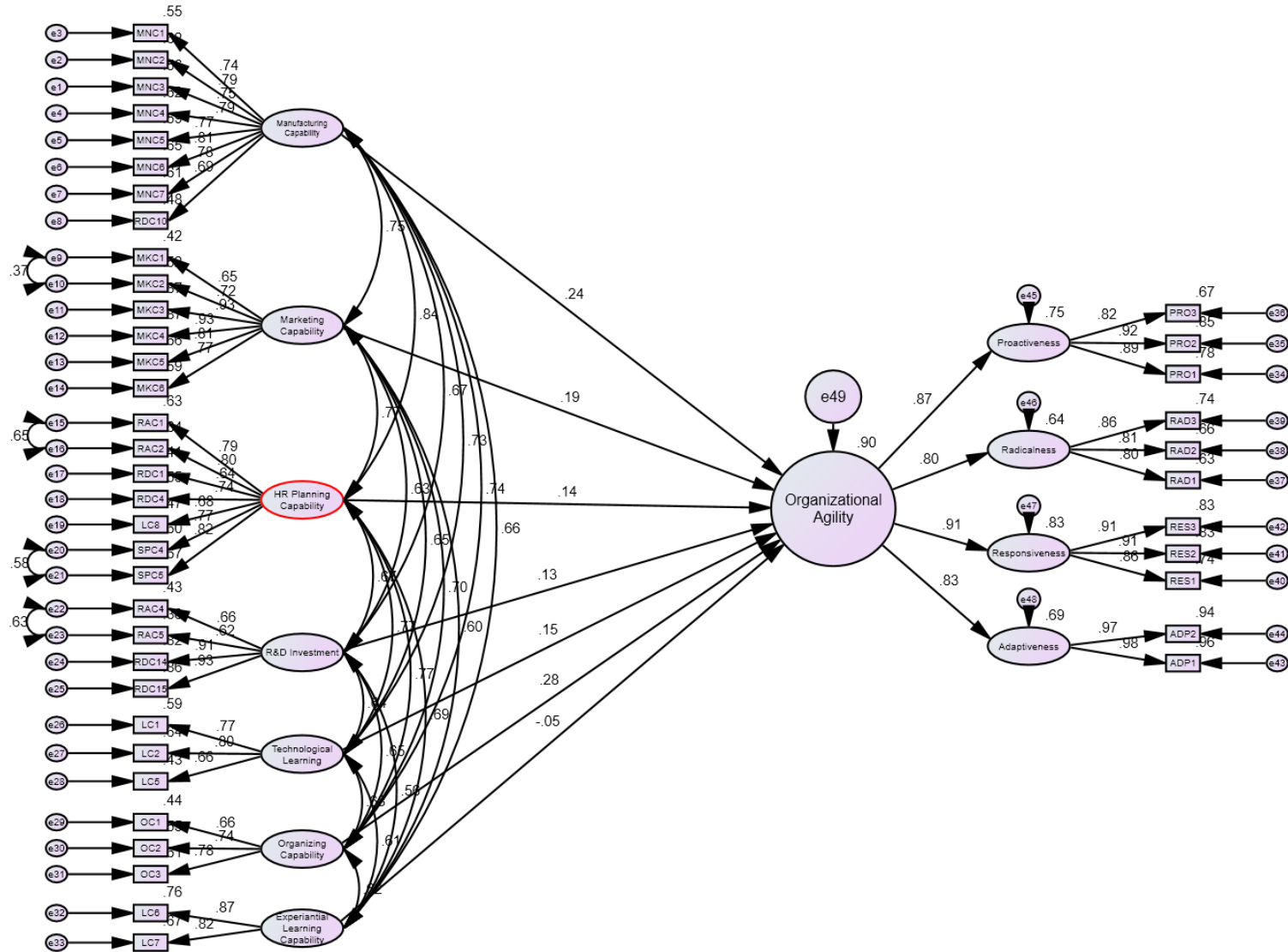


Figure 21 – Amos Map for SEM: Research Model I

Table 25 – Fit Statistics of Measurement for Model I

χ^2	df	χ^2/df	TLI	RMSEA	CFI	SRMR
1622,449*	866	1,873	,930	,052	,936	,0572

Note: * $p < .05$

Table 26 – Unstandardized Regression Estimates for Structural Equation Model I

			Estimate	S.E.	C.R.	P
Manufacturing Capability	→	Organizational Agility	0,27	0,082	3,292	***
Marketing Capability	→	Organizational Agility	0,171	0,051	3,387	***
HR Planning Capability	→	Organizational Agility	0,127	0,083	1,521	0,128
R&D Investment Capability	→	Organizational Agility	0,125	0,045	2,775	0,006
Technology Learning Capability	→	Organizational Agility	0,211	0,092	2,285	0,022
Organizing Capability	→	Organizational Agility	0,337	0,087	3,86	***
Experiential Learning	→	Organizational Agility	-0,05	0,049	-1,017	0,309

Table 27 – Standardized Regression Estimates for Structural Equation Model I

			Estimate
Manufacturing Capability	→	Organizational Agility	0,270
Marketing Capability	→	Organizational Agility	0,171
HR Planning Capability	→	Organizational Agility	0,127
R&D Investment Capability	→	Organizational Agility	0,125
Technology Learning Capability	→	Organizational Agility	0,211
Organizing Capability	→	Organizational Agility	0,337
Experiential Learning	→	Organizational Agility	-0,05

5.6.7.2. SEM Results for the Research Model II

In the research model II for this study, capabilities of technological innovation are mapped as the exogenous variables and the factors forming organizational agility (proactiveness, radicalness, responsiveness and adaptiveness) are drawn as the endogenous variable. The one-way direction arrows indicate the path analyses for the hypothesis testing. Two-way arrows represent the covariance relationships between the exogenous components. Also, the values indicated on the path arrows represent the standardized regression weights for the relationships.

Fit statistics for the structural equation analysis are shown in the table 28. CFI and TLI values are above 0.920 threshold and RMSEA and SRMR values are below 0.06 which is accepted as a good fit. These values show that the structural model proposed in this study is acceptable.

Furthermore, table for unstandardized estimates indicate the p-values for hypotheses for 28 path analyses. The results for each path are indicated in the respective tables.

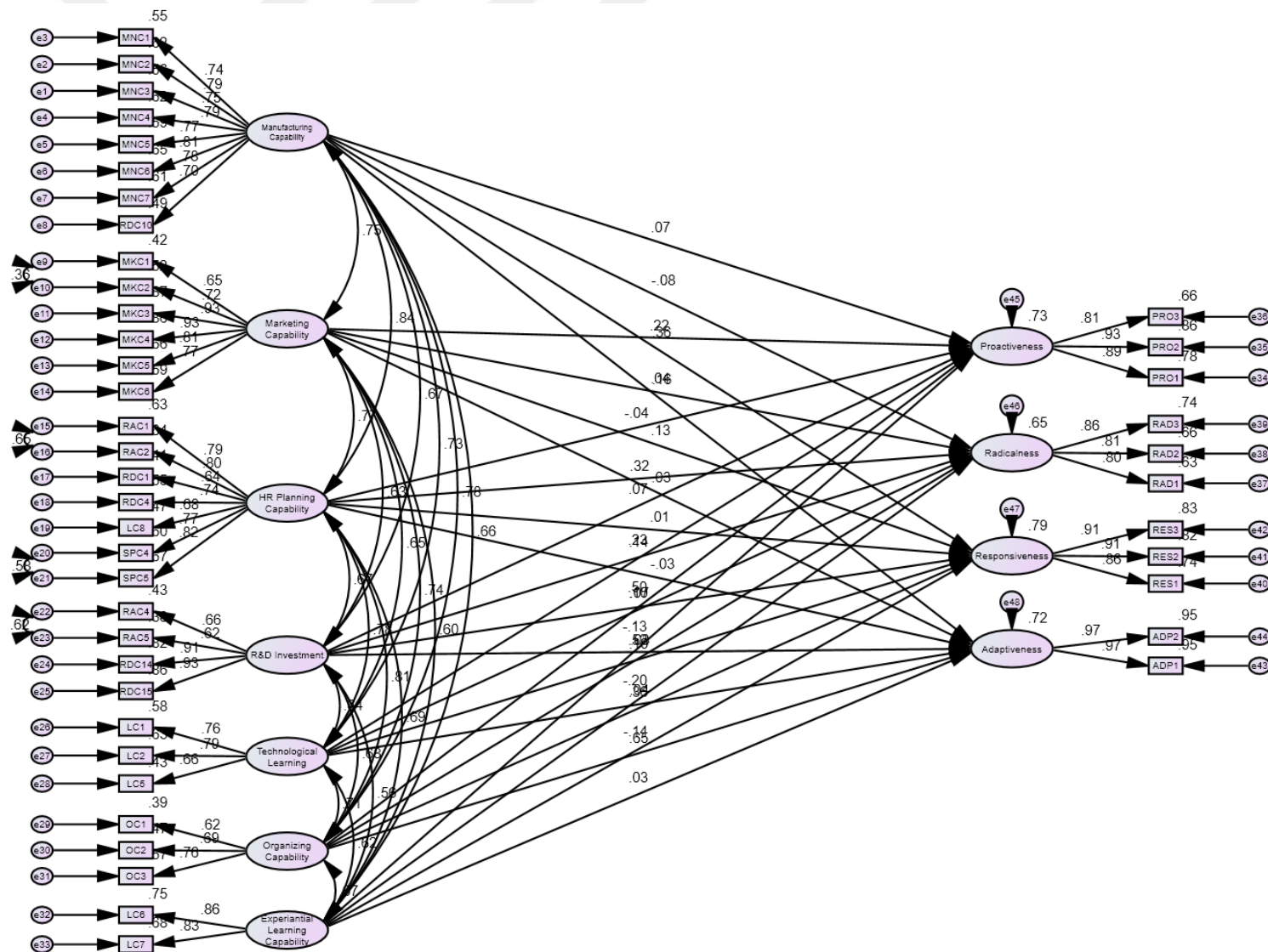


Figure 22 – Amos Map for SEM: Research Model II

Table 28 – Fit Statistics of Measurement for Model II

χ^2	df	χ^2/df	TLI	RMSEA	CFI	SRMR
1614,607*	849	1,902	,928	,053	,935	.0564

Note: * $p < .05$

Table 29 – Unstandardized Regression Estimates for Structural Equation Model II

			Estimate	S.E.	C.R.	P
Manufacturing Capability	→	Proactiveness	0,095	0,122	0,777	0,437
Manufacturing Capability	→	Radicalness	-0,103	0,141	-0,733	0,464
Manufacturing Capability	→	Responsiveness	0,404	0,098	4,145	***
Manufacturing Capability	→	Adaptiveness	0,186	0,114	1,638	0,101
Marketing Capability	→	Proactiveness	0,237	0,077	3,065	0,002
Marketing Capability	→	Radicalness	0,04	0,088	0,462	0,644
Marketing Capability	→	Responsiveness	0,12	0,059	2,037	0,042
Marketing Capability	→	Adaptiveness	0,025	0,071	0,346	0,729
HR Planning Capability	→	Proactiveness	-0,047	0,128	-0,367	0,714
HR Planning Capability	→	Radicalness	0,33	0,147	2,239	0,025
HR Planning Capability	→	Responsiveness	0,009	0,098	0,087	0,93
HR Planning Capability	→	Adaptiveness	-0,029	0,119	-0,246	0,806
R&D Investment Capability	→	Proactiveness	0,082	0,07	1,172	0,241
R&D Investment Capability	→	Radicalness	0,146	0,08	1,829	0,067
R&D Investment Capability	→	Responsiveness	0,063	0,054	1,179	0,238
R&D Investment Capability	→	Adaptiveness	0,03	0,065	0,457	0,648
Technology Learning Cap.	→	Proactiveness	0,374	0,143	2,612	0,009
Technology Learning Cap.	→	Radicalness	0,16	0,16	1,005	0,315
Technology Learning Cap.	→	Responsiveness	0,266	0,109	2,434	0,015
Technology Learning Cap.	→	Adaptiveness	0,058	0,13	0,45	0,653
Organizing Capability	→	Proactiveness	0,716	0,152	4,711	***

Organizing Capability	→	Radicalness	0,727	0,172	4,234	***
Organizing Capability	→	Responsiveness	0,445	0,113	3,934	***
Organizing Capability	→	Adaptiveness	0,868	0,152	5,695	***
Experiential Learning	→	Proactiveness	-0,146	0,076	-1,921	0,055
Experiential Learning	→	Radicalness	-0,227	0,088	-2,59	0,01
Experiential Learning	→	Responsiveness	-0,142	0,059	-2,425	0,015
Experiential Learning	→	Adaptiveness	0,031	0,07	0,444	0,657

Table 30 – Standardized Regression Estimates for Structural Equation Model II

			Estimates
Manufacturing Capability	→	Proactiveness	0,073
Manufacturing Capability	→	Radicalness	-0,081
Manufacturing Capability	→	Responsiveness	0,358
Manufacturing Capability	→	Adaptiveness	0,156
Marketing Capability	→	Proactiveness	0,224
Marketing Capability	→	Radicalness	0,039
Marketing Capability	→	Responsiveness	0,131
Marketing Capability	→	Adaptiveness	0,025
HR Planning Capability	→	Proactiveness	-0,044
HR Planning Capability	→	Radicalness	0,317
HR Planning Capability	→	Responsiveness	0,009
HR Planning Capability	→	Adaptiveness	-0,03
R&D Investment Capability	→	Proactiveness	0,074
R&D Investment Capability	→	Radicalness	0,135
R&D Investment Capability	→	Responsiveness	0,066
R&D Investment Capability	→	Adaptiveness	0,029
Technology Learning Cap.	→	Proactiveness	0,230
Technology Learning Cap.	→	Radicalness	0,101
Technology Learning Cap.	→	Responsiveness	0,188
Technology Learning Cap.	→	Adaptiveness	0,039
Organizing Capability	→	Proactiveness	0,498

Organizing Capability	→	Radicalness	0,516
Organizing Capability	→	Responsiveness	0,355
Organizing Capability	→	Adaptiveness	0,654
Experiential Learning	→	Proactiveness	-0,128
Experiential Learning	→	Radicalness	-0,204
Experiential Learning	→	Responsiveness	-0,144
Experiential Learning	→	Adaptiveness	0,030

5.6.8. Results of the Hypotheses

The outcomes of the hypotheses are presented in Table 31

. The interpretation of these results will be discussed in the next section with theoretical and practical implications.

Table 31 – Results of the Hypotheses		
Hypothesis		Result
h₁	Manufacturing capability affects organizational agility in positive direction.	Supported
h₂	Marketing capability affects organizational agility in positive direction.	Supported
h₃	HR planning capability affects organizational agility in positive direction.	Unsupported
h₄	R&D investment capability affects organizational agility in positive direction.	Supported
h₅	Technology learning capability affects organizational agility in positive direction.	Supported
h₆	Organizing capability affects organizational agility in positive direction.	Supported
h₇	Experiential learning capability affects organizational agility in positive direction.	Unsupported
h_{a1}	Manufacturing capability affects proactiveness in positive direction.	Unsupported
h_{a2}	Manufacturing capability affects radicalness in positive direction.	Unsupported
h_{a3}	Manufacturing capability affects responsiveness in positive direction.	Supported

h_{a4}	Manufacturing capability affects adaptiveness in positive direction.	Unsupported
h_{b1}	Marketing capability affects proactiveness in positive direction.	Supported
h_{b2}	Marketing capability affects radicalness in positive direction.	Unsupported
h_{b3}	Marketing capability affects responsiveness in positive direction.	Supported
h_{b4}	Marketing capability affects adaptiveness in positive direction.	Unsupported
h_{c1}	HR planning capability affects proactiveness in positive direction.	Unsupported
h_{c2}	HR planning capability affects radicalness in positive direction.	Supported
h_{c3}	HR planning capability affects responsiveness in positive direction.	Unsupported
h_{c4}	HR planning capability affects adaptiveness in positive direction.	Unsupported
h_{d1}	R&D investment capability affects proactiveness in positive direction.	Unsupported
h_{d2}	R&D investment capability affects radicalness in positive direction.	Unsupported
h_{d3}	R&D investment capability affects responsiveness in positive direction.	Unsupported
h_{d4}	R&D investment capability affects adaptiveness in positive direction.	Unsupported
h_{e1}	Technology learning capability affects proactiveness in positive direction.	Supported
h_{e2}	Technology learning capability affects radicalness in positive direction.	Unsupported
h_{e3}	Technology learning capability affects responsiveness in positive direction.	Supported
h_{e4}	Technology learning capability affects adaptiveness in positive direction.	Unsupported
h_{f1}	Organizing capability affects proactiveness in positive direction.	Supported
h_{f2}	Organizing capability affects radicalness in positive direction.	Supported
h_{f3}	Organizing capability affects responsiveness in positive direction.	Supported
h_{f4}	Organizing capability affects adaptiveness in positive direction.	Supported
h_{g1}	Experiential learning capability affects proactiveness in positive direction.	Unsupported
h_{g2}	Experiential learning capability affects radicalness in positive direction.	Unsupported
h_{g3}	Experiential learning capability affects responsiveness in positive direction.	Unsupported
h_{g4}	Experiential learning capability affects adaptiveness in positive direction.	Unsupported

6. DISCUSSION

In this section, the results of the statistical analyzes will be interpreted in detail, and the findings specific to this sample, which are reflected by the variables through exploratory factor analysis, will be discussed. In addition, the reasons for the positive effects of technological innovation capabilities on organizational agility will be argued and possible factors that can enable these results will be discussed. Since, there has not been any comprehensive research between technological innovation capabilities and organizational agility variables in the literature, the theoretical and practical implications will be presented rather than a comparison with the previous studies. Additionally, the limitations of the study are going to be indicated and suggestions for further research will be specified. Finally, in the last section, a short summary of the study will be stated, and the conclusion will be represented.

This research was designed to explore the relationship between technological innovation capabilities and organizational agility concepts. In addition to targeting organizations within the borders of Turkey as a sample, it was concluded that the most useful data would be obtained from the research and development centers in Turkey since the independent variables are a firm's innovation capabilities. Although there are still no specific departments for agile behavior in most of the companies within the borders of Turkey, the concept is very popular and is rapidly entering the agenda of the companies.

In order to close a gap in the literature, the main reason for targeting the relationship between two types of dynamic capabilities such as technological innovation capabilities and organizational agility is that although, there are still many organizations with high-level innovation capabilities in the industry, many of them are still not able to adapt quickly to sudden changes in the environment or take necessary proactive steps before the changes even occur. Thus, most organizations remain at fairly mediocre levels in responding to these rapid changes. Since in the information age we live in, technology is one of the fastest-changing parameters in the external environment, it makes it a critical requirement for companies to adapt to new technologies or to create their own technologies with their innovative skills. Therefore, the relationship between various essential or supporting innovation capabilities and organizational agility represents an undeniable importance.

6.1. Interpretations of the Exploratory Factor Analyses Results

Before examining the results of the structural equation models, exploratory factor analyses were applied to measure the efficiency of the instruments used in the study for collecting the necessary data on the companies in Turkey. When the background of the instruments was examined, it was determined that the measurement tool for TIC which is based on the work of Yam *et al.* (2004) was used only a few times in Turkish organizations. In addition to that, the measurement tool for OA which is based on the work of Sambamurthy *et al.* (2015) was used for the first time on Turkish organizations only in this study. Thus, it can be clearly stated that this research has closed a second gap in the literature by testing the validity of the OA instrument on Turkish companies.

The results of the exploratory factor analyses for the TIC scale show that the final values are within the necessary thresholds. For testing the reliability of the scale, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy and Bartlett's Test of Sphericity is used. The results show that the KMO value of the scale is “.946”, since a KMO value above “.90” is indicated as marvelous (Kaiser, 1974), it can be regarded as adequate. In addition to that, since Bartlett's Test of Sphericity p-value is “,000” which is below “,05”, it supports that the variable is appropriate for further analyses. Lastly, seven factors are able to explain %70.76 of the total variance.

In the final EFA for TIC scale, it can be clearly seen that there are noticeable changes between the TIC dimensions of the theoretical model and the modified research model. While some of the factors remained the same, others showed major changes since the scale is still arguably not perfected for Turkish organizations. Since perceptions of the concepts may differ dramatically between various cultures and organization types, the formation of new factors cannot be regarded as unexpected.

In addition, although the number of items deleted from the TIC scale as a result of EFA can be interpreted as a high number at first glance, but when studies that utilized this scale for the data collection are examined, it can be understood that it is quite normal to remove an above-average number of items. For example, when the CFA modelling was examined in the study of İnce *et al.* (2011), it can be seen that only 31 questions of the 66-item scale passed the analysis successfully. Similar to that, in the CFA results of the study of Yam *et al.* (2011), only 24 items remained of the whole scale. The reason for this can be explained by several different reasons. It can be considered that the scale contains more than the average number of items when

compared to many general social science scales regarding the management science. While the scale aims to measure many organizational capabilities in detail, item losses may be higher than normal because closely related items lead to overlapping or cross-loading results. Simplification of the questionnaire may allow more precise data to be collected in future research may increase the expectation of producing healthier results.

When the modified research model is examined, manufacturing capability, marketing capability, and organizing capability factors remained the same when compared to the theoretical factors of the scale. Learning capability is a factor that is separated into two specific factors labeled as technology learning capability and experiential learning capability since the items grouped under the new factors retain statements about learning from technologies and learning from past experiences exclusively. Furthermore, it can be seen that some of the items which are specially designed for measuring R&D capability, resource allocation capability, and strategic planning capability are removed due to the low factor loadings, and the remaining items formed new factors which are HR planning capability and R&D investment capability. HR planning capability factor statements mainly focused on the organization of human resources, rewarding creativity and inventiveness, and establishing clear goals, targets, standards, and roadmaps for the employees. Lastly, the R&D investment capability factor is formed of the items that state “capital supplement for innovation”, “flexibility and diversity of capital origins”, and levels of R&D investments for new products and new processes. Accordingly, the factor is labeled as R&D investment capability.

The results of the exploratory factor analyses for the OA scale show that the final values are also within the necessary thresholds. The KMO value of the scale is “.904”, which is also regarded as marvelous (Kaiser, 1974). Furthermore, Bartlett’s Test of Sphericity p-value is “,<000” which is below “,<05”, meaning the variable is appropriate for further analyses. Lastly, four factors are able to explain %85.95 of the total variance.

The items present in the OA scale are distributed precisely the same when compared to the theoretical model. Factors are responsiveness, radicalness, proactiveness, and adaptiveness that represent the agility aspects of an organization.

6.2. Interpretations of the Confirmatory Factor Analyses, Convergent Validity and Discriminant Validity Results

The results of the confirmatory factor analyses of the TIC and OA scales show that the comparative fit index (CFI), Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR) values are within the necessary thresholds which proves that the hypothesized model fit the gathered data appropriately.

When the results of convergent and discriminant validity analyses are examined, it is seen that each factor constituting the TIC and OA variables reaches an average variance extracted (AVE) value above the required limits (,50 and above). Furthermore, composite reliability (CR) values are also above necessary thresholds (,70 and above) for each factor. According to the results of the Fornell-Larcker testing system, the OA construct reaches to the square root of the AVE values for each factor that shows higher values than the correlations in between. Therefore, it can be easily said that the OA measuring scale of Sambamurthy *et al.* (2015) proved its convergent and discriminant validity on a sample composed of Turkish organizations for the first time.

According to the results of the Fornell-Larcker discriminant validity testing system, TIC scale shows some levels of high correlation above the square root of the AVE values of the factors. This can be explained by several reasons. Firstly, the TIC scale is composed of multiple organizational capabilities. Based on the dynamic capabilities approach, organizations can have capabilities in multiple layers. These can occur at different tiers, such as core capabilities, supporting capabilities, strategic capabilities, and dynamic capabilities. However, in the theoretical approaches found in the literature, although these abilities are not separated from each other with certain borders, it is even argued that they form an endless continuum. In addition, the capabilities essential for the innovativeness and sustainability of an organization encompass a wide range of skills and competencies. Therefore, it is not uncommon to find high correlations between comprehensive factors in constructs that choose the level of analysis as organization wide. Moreover, when the pattern matrix values obtained in the exploratory factor analysis are examined, it is determined that there are no cross-loadings between the indicators that form the factors.

6.3. Interpretations of the Results of the SEM - Model I

Path diagram for the research Model I is designed for investigating the effects of technological innovation capabilities on organizational agility while evaluating organizational agility as a whole construct.

When the values obtained as a result of the path analysis executed on the path diagram that is designed for Model I are examined, the values of fitness for the model were determined within the necessary limits (CFI: 0,936; TLI: 0,930; RMSEA: 0,052; SRMR: 0,057). Furthermore, when the values representing the relationships between technological innovation capabilities and organizational agility are examined, it is seen that manufacturing capability, marketing capability, R&D investment capability, technology learning capability, and organizing capability have a significant positive effect on organizational agility. It was concluded that HR planning capability and experiential learning capability do not have a significant effect on organizational agility. Moreover, when the effect weights of technological innovation capabilities are evaluated, it is determined that they are ordered from strong to weak as organizing ability, manufacturing ability, technology learning ability, marketing ability and R&D investment ability.

6.4. Interpretations of the Results of the SEM - Model II

Path diagram for the research Model II is designed for investigating the effects of technological innovation capabilities on the dimensions of organizational agility which are proactiveness, responsiveness, radicalness, and adaptiveness.

When the values obtained as a result of the path analysis executed on the path diagram that is designed for Model II are examined, the values of fitness for the model were determined within the necessary limits (CFI: 0,935; TLI: 0,928; RMSEA: 0,053; SRMR: 0,056). Furthermore, when the values representing the relationships between technological innovation capabilities and proactiveness, radicalness, responsiveness, and adaptiveness are examined, it is determined that the organizing capability has a strong positive effect on all four dimensions of organizational agility. In addition to that, positive effects of marketing capability on proactiveness and responsiveness have been confirmed, while manufacturing capability has only a positive effect on responsiveness. Moreover, it is determined that technology learning

capability has a positive effect on proactiveness and responsiveness similar in strength to marketing ability, while HR planning capability shows a positive effect only on radicalness.

Although it was confirmed in the model I analysis that R&D investment capability shows an overall positive effect on organizational agility, no significant effect was detected on sub-factors separately. Experiential learning capability, on the other hand, does not show a significant effect on organizational agility or its subfactors in both model I and model II analyses respectively.

6.5. Theoretical Implications

In this study, multiple exploratory factor analyses are executed to investigate the conformity between the theoretical model and the statistical results of the data gathered from the field. Through these validations, some new conceptual information is identified. Main theoretical implications of the study are as follows;

- During this research which is focused on the R&D centers in Turkey, although the TIC variable was based on the study of Yam *et al.* (2011), it was observed that the sub-dimensions differed significantly after multiple exploratory factor analyses.
- The results show that some of the conceptual factors are eliminated and some new ones are formed. While manufacturing capability, marketing capability, and organizing capability factors remained the same, the data provided by the managerial-level employees of the R&D centers altered the rest of the factors dramatically.
- One of the most striking results is that although the research is focused on R&D centers as the sample, most of the phrases representing R&D activities used to measure R&D capabilities in the scale could not find satisfactory-level responses in Turkish companies. Therefore, a clear-cut sub-dimension of R&D capability has not emerged, instead the R&D investment dimension is formed in its place. This can be interpreted as that the funding allocated to R&D is much more prominent than the actual R&D activities themselves in the Turkish organizations.

- Another striking output is that although such a factor does not exist in the theoretical model of the original study, the answers given clustered under a completely different capability. Human resources planning capability shows that the activities under distinct organizational capabilities proved a pattern regarding the activities of human resource planning actions that indicates the importance, planning and coordination of the human resources, encouraging and rewarding the creative and innovative behavior of the employees, investments on the learning activities, and setting clear goals and plans for the workforce.
- Furthermore, learning capability has been divided into more specific and definitive sub-dimensions labeled as technology learning and experiential learning. Technology learning factor focused on monitoring actions for the emerging technological trends, coordinating the internal core competencies and external market needs with necessary technological capabilities, and assessing required technology needs for the company's strategical actions. On the other hand, experiential learning represents the importance of organizations to learn from their experiences and to transfer these lessons to all employees in a constant cycle, regardless of whether the employees are new recruits or old-timers.
- Contrary to the changes encountered in the technological innovation capabilities, organizational agility variable remained intact and its sub-dimensions formed patterns precisely the same as the theoretical model. This shows that although it is not certain that most of the R&D centers in Turkey are consciously aware of the concept of agility, they act in parallel with activities that represent the sub-dimensions of proactiveness, responsiveness, radicalness and adaptiveness.

In conclusion, the results of the analyses proved major changes in the theoretical framework of the study which are critical contributions to the literature.

6.6. Practical Implications

In this study, multiple hypotheses are tested to investigate the relationship between specific capabilities of an organization which improves the technological innovativeness of the firm and its agile behavior. Through the results of these hypotheses, various practical implications are identified and reported as follows;

- Self-managing teams with powerful autonomy improve the overall agile behavior of the sample companies. In addition, results show that the capacity to manage multiple innovative projects in harmony enables the firms to act proactively to get ready for market changes before they actually take place. Moreover, organizations with a flexible structure indicate an improved capacity for quick response and rapid adaptation to the new conditions in the market such as new product or service types released by the companies or new trend approaches chosen by the customer groups.
- Similarly, agile dynamics are also improved by the manufacturing capabilities such as well-qualified manufacturing personnel, up-to-date equipment and the synergy between R&D and manufacturing departments.
- Marketing dynamics such as the relationship with the customers and improved knowledge about the market segments enable the organization to prepare proactive strategies for detecting and exploiting new business opportunities. Additionally, a well-established marketing system improves the response rate for reacting rapidly to the customer needs and environmental opportunities.
- The balanced and collaborative management of human resources show a higher chance of success rate for the integration of radical and experimental changes.
- The absence of a constraint in funding R&D activities does not show any impact on the agility activities of the companies.
- Monitoring, assessing and acquiring new technologies in the industry shows an increase in the agile dynamics of the organization, especially in the identification of the niche or emerging markets.
- Experiential learning activities do not prove any developments on the levels of the agility dynamics in the R&D centers in Turkey.

6.7. Limitations and Future Directions

As for all studies that are executed with limited resources and time, there are certain limitations in this research.

- One of the most threatening constraints is that the sample candidates for whom data should be provided are those who work at the management level, since the research is conducted at the organizational level. Since managerial level employees usually can spare very limited time to survey answering, it can bottleneck the data collection process.
- Since the independent variable in the research model needs information from multiple departments, it cannot always be possible to reach a senior manager with all departmental information. For further studies, it would be healthier to collect the data from the respective department heads for the questions regarding the capabilities of each department/function so that the research can be carried out in a near-perfect manner.
- Scope of the study is limited only with the R&D centers in Turkey. Future studies can expand the boundaries and focus on multiple organization types and compare the relationship results.
- While the adaptation and validation of the measurement tool of organizational agility proved no inconsistency through the research process, scale of technological innovation capabilities arguably can be accepted as conforming assessment tool for Turkish organizations. The fact that the scale is designed with high number of items for a very detailed measurement due to its structure increases the existence of phrases that are closely similar to each other and poses a great disadvantage in the stage of presenting it to senior managers. For further research, through some pilot studies and focus groups, it can be easier to decrease the item number to gather more definitive information.

7. CONCLUSION

This study contributed to the literature at more than one point during the research process. To state these contributions from a few different perspectives, it is primarily important to emphasize that there is no study in the literature that examines the effects of technological innovation capabilities on organizational agility. Examining the organization from a holistic point of view, in addition to its vital and basic competencies, the effect of dynamic capabilities of integration and quickness abilities of the enterprise shows utmost importance. In addition, the reshaping of the theoretical framework of technological innovation capabilities in line with the data obtained in the study reveals the differences in organizational capability perceptions of organizations in Turkey. Furthermore, it has been revealed that the organizational capabilities and agility dynamics of the R&D centers chosen as the research sample may be different from the standard organizations. The result that organizing capability can affect agility skills in every aspect and in the strongest way has revealed that intra-organizational coordination is much more important than department-based actions. The fact that marketing and technology learning capabilities increase R&D centers' awareness of their environment in a proactive and responsive way has shown once again how vital these capabilities are. The fact that the sample is R&D centers but the data cannot bring forth the R&D capability can be considered as a sign that the R&D dynamics in Turkey may still not be mature enough. In addition to all these solid and illuminating implications, the fact that the organizational agility scale used in the research is implemented for the first time in Turkey highlights that this research makes a great contribution to the adaptation and validation of the scale.

In line with all this information, the fact that the external environment is constantly and rapidly changing is an important sign for companies to put on their agenda the activities of generating and developing the talents necessary for their survival. These capabilities are leverage that will provide competitive advantage in the short term and sustainability in the long term. Beyond this, the necessity of organizations to have proactive action plans and to implement radical changes quickly, beyond the ability to react quickly with a flexible structure, has gained more critical importance.

In conclusion, the guiding information that this research offers to the literature and industry, both in the theoretical and practical context, are very critical that it cannot be ignored. It is not an option but a necessity for companies to maintain their organizational integrity, never neglect their organizational skills, and always be active and aware.

REFERENCES

- Aaker, D.A. (1989). Managing assets and skills: a key to sustainable competitive advantage. *California Management Review*, Vol. 31 No. 1, pp. 91-106.
- Abernathy, W. J. (1978). *The productivity dilemma*. Baltimore, MD: Johns Hopkins University Press.
- Abraham, B. P., & Moitra, S. D. (2001). Innovation assessment through patent analysis. *Technovation*, 21(4), 245-252.
- Acs, Z. J., & Audretsch, D. B. (1988). Innovation in large and small firms: an empirical analysis. *The American economic review*, 678-690.
- Adler, P. S., Goldoftas, B., & Levine, D. I. (1999). Flexibility versus efficiency? A case study of model changeovers in the Toyota production system. *Organization science*, 10(1), 43-68.
- Akkaya, B., & Tabak, A. (2018). Örgütsel çeviklik ölçeğinin Türkçeye uyarlanması: Geçerlik ve güvenirlik çalışması. *İş ve İnsan Dergisi*, 5(2), 185-206.
- Akkaya, B., Kayalidere, U. A. K., & Tabak, A. (2019). Endüstriyel alanda üretim yapan firmaların örgütsel çevikliği ile firma yöneticilerinin sahip olduğu dinamik yetenekler arasındaki ilişki: manisa organize sanayi bölgesinde (mosb) faaliyet gösteren firmalar üzerine bir araştırma. *Yeni Nesil Girişimcilik ve Ekonomi*, 1(2), 19-54.
- Alarcón, D., Sánchez, J. A., & De Olavide, U. (2015, October). Assessing convergent and discriminant validity in the ADHD-R IV rating scale: User-written commands for Average Variance Extracted (AVE), Composite Reliability (CR), and Heterotrait-Monotrait ratio of correlations (HTMT). In *Spanish STATA meeting* (Vol. 39, pp. 1-39).
- Al-Faouri, E. H., & Al-Rfou, A. N. (2017). The Impact of the Failure-based Learning Behavior on Organizational Agility from the Workers' Point of View in the Jordanian Industrial Companies in King Abdullah II Industrial City-Sahab. *International Review of Management and Marketing*, 7(3), 266-273.
- Anderson, P. and Tushman, M. (1990). 'Technological Discontinuities and Dominant Designs: A Cyclical Model of Technological Change', *Administrative Science Quarterly*, 35(4): 604-34.
- Andrews, K. R. (1971). *The Concept of Corporate Strategy*. Homewood, IL: Irwin.
- Archibugi, D. (1992). Patenting as an indicator of technological innovation: a review. *Science and public policy*, 19(6), 357-368.
- Aziati, A. N., Tasmin, R. H., Jia, L. B., & Abdullah, N. H. (2014). The relationship of technological innovation capabilities and business innovation capabilities on organization performance: Preliminary findings of Malaysian food processing SMEs. In *2014 International Conference on Engineering, Technology and Innovation (ICE)* (pp. 1-8). IEEE.

Baloch, M. A., Meng, F., & Bari, M. W. (2018). Moderated mediation between IT capability and organizational agility. *Human Systems Management*, 37(2), 195–206.

Baninam, J., & Amirnejad, Q. (2017). The Effects of Organizational Agility on the Organizational Performance: Mediating Role of Knowledge Management. *International Journal of Economic Perspectives*, 11(1), 1227-1240.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of management*, 17(1), 99-120.

Barney, J. B. (1986). Organizational culture: Can it be a source of sustained competitive advantage? *Academy of Management Review*, 11(3), 656–665

Barney, J. B., & Clark, D. N. (2007). Resource-based theory: Creating and sustaining competitive advantage. OUP Oxford.

Barney, J. B., & Hesterly, W. S. (2010). VRIO framework. *Strategic management and competitive advantage*, 3, 68-86.

Basadur, M., Gelade, G., & Basadur, T. (2014). Creative problem-solving process styles, cognitive work demands, and organizational adaptability. *The journal of applied behavioral science*, 50(1), 80-115.

Başkarada, S., & Koronios, A. (2018). The 5S organizational agility framework: a dynamic capabilities perspective. *International Journal of Organizational Analysis*, 26(2), 331–342.

Behrouz, A. H., & Amirnejad, Q. (2017). Investigation of the Effect of Accountability on the Organizational Agility: Evidence from the National Companies of Oil Regions of the South Iran. *Journal of Economic & Management Perspectives*, 11(1), 1206-1220.

Bessant, J., Francis, D., Meredith, S., Kaplinsky, R., & Brown, S. (2000). Developing manufacturing agility in SMEs. *International Journal of Manufacturing Technology and Management*, 2(1-7), 730-756.

Burgelman, R. A., Christensen, C. M., & Wheelwright, S. C. (2004). Integrating technology and strategy: A general management perspective. *Strategic management of technology and innovation*, 208.

Burgelman, R. A., Christensen, C. M., & Wheelwright, S. C. (2008). Strategic management of technology and innovation. McGraw-Hill/Irwin.

Burgelman, R., Maidique, M., & Wheelwright, S. (2004). Strategic management of technology and innovation: Times Mirror Higher Education Group.

Campbell, D. T. & Fiske, D. W. (1959) Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological bulletin*, 56-81

Chen, D. Z., Lin, W. Y., & Huang, M. H. (2007). Using essential patent index and essential technological strength to evaluate industrial technological innovation competitiveness. *Scientometrics*, 71(1), 101-116.

Chen, Q., Wang, C. H., & Huang, S. Z. (2019). Effects of organizational innovation and technological innovation capabilities on firm performance: evidence from firms in China's Pearl River Delta. *Asia Pacific Business Review*, 1-25.

Chen, Y., Yang, Z., Shu, F., Hu, Z., Meyer, M., & Bhattacharya, S. (2009). A patent based evaluation of technological innovation capability in eight economic regions in PR China. *World Patent Information*, 31(2), 104-110.

Chesbrough, H. (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Cambridge, MA: Harvard Business School Press.

Chiesa, V., Coughlan, P., & Voss, C. A. (1996). Development of a technical innovation audit. *Journal of Product Innovation Management: an international publication of the product development & management association*, 13(2), 105-136.

Chirico, F. & Nordqvist, M. (2010). Dynamic capabilities and trans-generational value creation in family firms: The role of organizational culture. *International Small Business Journal*, 28(5), 487-504.

Cho H., Jung M., Kim M. (1996). Enabling technologies of agile manufacturing and its related activities in Korea. *Comput Ind Eng* 30(3):323–334.

Choi, S. & Moon, T. (2015). The influence of resource competence on convergence performance through dynamic convergence capabilities. *Indian Journal of Science and Technology*, 8(25), 1-9.

Christensen, C. (1997). *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Boston, MA: Harvard Business School Press.

Christensen, J. F. (1995). Asset profiles for technological innovation. *Research Policy*, 24(5), 727-745.

Collis, D. J., & Montgomery, C. A. (2009). Competing on Resources: Strategy in the 1990s. In *Knowledge and strategy* (pp. 25-40). Routledge.

Conner, K. R. (1991). A historical comparison of resource-based theory and five schools of thought within industrial organization economics: do we have a new theory of the firm?. *Journal of management*, 17(1), 121-154.

Damanpour, F. (1991), "Organizational innovation: a meta-analysis of effects of determinants and moderators", *Academy of Management Journal*, Vol. 34 No. 3, pp. 555-590.

Damanpour, F., & Evan, W. M. (1984). Organizational innovation and performance: the problem of "organizational lag". *Administrative science quarterly*, 392-409.

Day, G. S. (1994). The capabilities of market-driven organizations. *Journal of marketing*, 58(4), 37-52.

Day, G. S. (1994). The capabilities of market-driven organizations. *Journal of marketing*, 58(4), 37-52.

Day, G. S., & Wensley, R. (1988). Assessing advantage: a framework for diagnosing competitive superiority. *Journal of marketing*, 52(2), 1-20.

De Jong, J. P., & Kemp, R. (2003). Determinants of co-workers' innovative behaviour: An investigation into knowledge intensive services. *International Journal of Innovation Management*, 7(02), 189-212.

Deng, P., & Wang, R. (2007). Study on evaluation system of innovation capabilities in manufacturing firms. In *Papers in International Conference on Management Science and Engineering*.

Dhewanto, W., Prasetyo, E. A., Ratnaningtyas, S., Herliana, S., Chaerudin, R., Aina, Q., & Rachmawaty, E. (2012). Moderating effect of cluster on firm's innovation capability and business performance: A conceptual framework. *Procedia-Social and Behavioral Sciences*, 65, 867-872.

Dierickx, I., & Cool, K. (1989). Asset stock accumulation and sustainability of competitive advantage. *Management science*, 35(12), 1504-1511.

Dobni, C. B. (2008). Measuring innovation culture in organizations: The development of a generalized innovation culture construct using exploratory factor analysis. *European journal of innovation management*.

Dodgson, M., Gann, D. M., & Salter, A. (2008). *The management of technological innovation: strategy and practice*. Oxford University Press on Demand.

Dove, R. (2005, May). Agile enterprise cornerstones: knowledge, values, and response ability. In *IFIP International Working Conference on Business Agility and Information Technology Diffusion* (pp. 313-330). Springer, Boston, MA.

Doz, Y. L., & Kosonen, M. (2010). Embedding strategic agility: A leadership agenda for accelerating business model renewal. *Long range planning*, 43(2-3), 370-382.

Dyer, L., & Shafer, R. A. (1998). From human resource strategy to organizational effectiveness: Lessons from research on organizational agility.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: what are they?. *Strategic management journal*, 21(10-11), 1105-1121.

Eisenhardt, K.M. & Martin, J.A. (2000). Dynamic capabilities: what are they? *Strategic Management Journal*, 21(10-11), 1105-1121.

Evans, J. S. (1991). Strategic flexibility for high technology manoeuvres: a conceptual framework. *Journal of management studies*, 28(1), 69-89.

Faridah, binti Taju Rahim, and Yuserrie, bin Zainuddin (2017). Moderating effect of environmental turbulence on firm's technological innovation capabilities (TIC) and business performance in the automotive industry in Malaysia: A conceptual framework. In *MATEC Web of Conferences* (Vol. 90, p. 01009).

Felipe, C. M., Roldán, J. L., & Leal-Rodríguez, A. L. (2016). An explanatory and predictive model for organizational agility. *Journal of Business Research*, 69(10), 4624-4631.

Feng S.C., Zhang C. (1998). A modular architecture for rapid development of CAPP systems for agile manufacturing. *IIE Trans* 30(10):893–903.

Fornell, C. & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research*, 39-50.

Forsman, H. (2011). Innovation capacity and innovation development in small enterprises. A comparison between the manufacturing and service sectors. *Research policy*, 40(5), 739-750.

Freeman, C. (1974). *The Economics of Industrial Innovation*. London: Pinter.

Freeman, C. (1994), "The economics of technical change", *Cambridge Journal of Economics*, Vol. 18 No. 5, pp. 463-514.

Ganguly, A., Nilchiani, R., & Farr, J. V. (2009). Evaluating agility in corporate enterprises. *International Journal of Production Economics*, 118(2), 410-423.

Goldman S L, Nagel R N and Preiss K (1995), *Agile Competitors and Virtual Organizations: Strategies for Enriching the Customer*, Van Nostrand Reinhold, NY.

Goldman, S. L., Nagel, R. N., & Preiss, K. (1995). *Agile competitors and virtual organizations: strategies for enriching the customer* (Vol. 8). New York: Van Nostrand Reinhold.

Goldman, S. L., Nagel, R. N., Preiss, K., & Dove, R. (1991). Iacocca institute: 21st century manufacturing enterprise strategy. *An Industry Led View*, 1.

Grant, R. M. (1991). The resource-based theory of competitive advantage: implications for strategy formulation. *California management review*, 33(3), 114-135.

Grant, R. M. (1991). The resource-based theory of competitive advantage: implications for strategy formulation. *California management review*, 33(3), 114-135.

Green, S. G., Gavin, M. B., & Aiman-Smith, L. (1995). Assessing a multidimensional measure of radical technological innovation. *IEEE Transactions on Engineering Management*, 42(3), 203–214. doi:10.1109/17.403738

Guan, J. C., Yam, R. C., Mok, C. K., & Ma, N. (2006). A study of the relationship between competitiveness and technological innovation capability based on DEA models. *European journal of operational research*, 170(3), 971-986.

Guan, J., & Ma, N. (2003). Innovative capability and export performance of Chinese firms. *Technovation*, 23(9), 737-747.

Gunasekaran, A. (1998). Agile manufacturing: enablers and an implementation framework. *Int J Prod Res* 36(5):1223–1247.

Gunasekaran, A., & Yusuf, Y. Y. (2002). Agile manufacturing: a taxonomy of strategic and technological imperatives. *International Journal of Production Research*, 40(6), 1357-1385.

Hage, J. T. (1999). Organizational innovation and organizational change. *Annual review of sociology*, 25(1), 597-622.

Hage, J., Meeus, M., & Meeus, M. T. (Eds.). (2006). *Innovation, science, and institutional change: a research handbook*. Oxford University Press on Demand.

Hair Jr., J. F. et al. (1998). *Multivariate Data Analysis with Readings*. Englewood Cliffs, NJ: Prentice-Hall.

Hair, J. F., Page, M., & Brunsveld, N. (2019). *Essentials of business research methods*. Routledge.

Hansen, G. S., & Wernerfelt, B. (1989). Determinants of firm performance: The relative importance of economic and organizational factors. *Strategic management journal*, 10(5), 399-411.

Hansen, G. S., & Wernerfelt, B. (1989). Determinants of firm performance: The relative importance of economic and organizational factors. *Strategic management journal*, 10(5), 399-411.

Harraf, A., Wanasika, I., Tate, K., & Talbott, K. (2015). Organizational agility. *Journal of Applied Business Research (JABR)*, 31(2), 675-686.

Hassan, M. (2022). State of IoT 2022: Number of connected IoT devices growing 18% to 14.4 billion globally. *IoT Analytics Research*. <https://iot-analytics.com/number-connected-iot-devices/>

Helfat, C.E., Finkelstein, S., Mitchell, W., Peteraf, M., Singh, H., Teece, D. & Winter, S.G. (2007). *Dynamic capabilities: Understanding strategic change in organizations*. Malden, MA: Blackwell Publishing.

Henderson, R. and Clark, K. (1990). 'Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms', *Administrative Science Quarterly*, 35 (SI Technology, Organizations, and Innovation): 9–30.

Hormozi, A. M. (2001). Agile manufacturing: the next logical step. *Benchmarking: An international journal*, 8(2), 132-143.

Huang, H. C. (2011). Technological innovation capability creation potential of open innovation: a cross-level analysis in the biotechnology industry. *Technology Analysis & Strategic Management*, 23(1), 49-63.

Ince, H., Imamoglu, S. Z., & Turkcan, H. (2016). The effect of technological innovation capabilities and absorptive capacity on firm innovativeness: a conceptual framework. *Procedia-Social and Behavioral Sciences*, 235, 764-770.

Irfan, M., Wang, M., & Akhtar, N. (2019). Impact of IT capabilities on supply chain capabilities and organizational agility: a dynamic capability view. *Operations Management Research*, 12(3), 113-128.

İşcan, Ö. F., & Karabey, A. G. C. N. (2006). Bilgi Teknolojilerinin Benimsenmesi İle Örgütsel Atıklık Arasındaki İlişki Üzerine Bir Araştırma. *Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, (26).

J. Hage (1980). *Theories of Organization: Form, Process and Transformation*. New York: John Wiley & Sons.

Johnstone, N., Haščič, I., Poirier, J., Hemar, M., & Michel, C. (2012). Environmental policy stringency and technological innovation: evidence from survey data and patent counts. *Applied Economics*, 44(17), 2157-2170.

Joo, H. Y., Seo, Y. W., & Min, H. (2018). Examining the effects of government intervention on the firm's environmental and technological innovation capabilities and export performance. *International Journal of Production Research*, 56(18), 6090-6111.

Jun, S., & Sung Park, S. (2013). Examining technological innovation of Apple using patent analysis. *Industrial Management & Data Systems*, 113(6), 890-907.

Kanani, N. (2016). Analysis of Factors Affecting Organizational Agility. *Singaporean Journal of Business Economics and Management Studies*, 5(2), 102-108.

Katkalo, V. S., Pitelis, C. N., & Teece, D. J. (2010). Introduction: On the nature and scope of dynamic capabilities. *Industrial and corporate change*, 19(4), 1175-1186.

Kim, S. K., Lee, B. G., Park, B. S., & Oh, K. S. (2011). The effect of R&D, technology commercialization capabilities and innovation performance. *Technological and Economic Development of Economy*, 17(4), 563-578.

Kingsley, O. O., & Onuoha, B. C. (2019). Workplace reputation and organizational agility of oil and gas firms in rivers state. *Electronic Research Journal of Behavioural Sciences*, 2, 38-51.

Kleinknecht, A. and Mohnen, P. (eds.) (2002). *Innovation and Firm Performance: Econometric Explorations of Survey Data*. London: Palgrave Macmillan.

Koc, T., & Ceylan, C. (2007). Factors impacting the innovative capacity in large-scale companies. *Technovation*, 27(3), 105-114.

Kraaijenbrink, J., Spender, J. C., & Groen, A. J. (2010). The resource-based view: A review and assessment of its critiques. *Journal of management*, 36(1), 349-372.

Kyrgidou, L. P., & Spyropoulou, S. (2013). Drivers and performance outcomes of innovativeness: An empirical study. *British Journal of Management*, 24(3), 281-298.

Lau, A. K., Yam, R. C., & Tang, E. P. (2010). The impact of technological innovation capabilities on innovation performance: An empirical study in Hong Kong. *Journal of Science and Technology Policy in China*, 1(2), 163-186.

Lee, O. K., Sambamurthy, V., Lim, K. H., & Wei, K. K. (2015). How does IT ambidexterity impact organizational agility?. *Information Systems Research*, 26(2), 398-417.

Lee, P.Y., Lin, H.T., Kim, H.J. & Shyr, Y.H. (2011). Knowledge articulation and dynamic capabilities in firm collaborations: An empirical comparison of Taiwanese and South Korean Enterprises. *African Journal of Business Management*, 5(11), 4196-4208.

Levitas, E., & McFadyen, M. A. (2009). Managing liquidity in research-intensive firms: signaling and cash flow effects of patents and alliance activities. *Strategic Management Journal*, 30(6), 659-678.

Liang, H., Wang, N., Xue, Y., & Ge, S. (2017). Unraveling the Alignment Paradox: How Does Business—IT Alignment Shape Organizational Agility?. *Information Systems Research*, 28(4), 863-879.

Lim, J.H., Stratopoulos, T.C. & Wirjanto, T.S. (2011). Path dependence of dynamic information technology capability: An empirical investigation. *Journal of Management Information Systems*, 28(3), 45-84.

Li-Ming, Z., Qi, C., Rui, Z., Jing, X., & Tian-Jiao, L. (2017, August). Research on Evaluation System of Enterprise's Scientific and Technological Innovation Capability: From the Perspective of Dynamic Capability. In 2017 International Conference on Management Science and Engineering (ICMSE) (pp. 137-143). IEEE.

Li-Ming, Z., Qi, C., Rui, Z., Jing, X., & Tian-Jiao, L. (2017, August). Research on Evaluation System of Enterprise's Scientific and Technological Innovation Capability: From the Perspective of Dynamic Capability. In 2017 International Conference on Management Science and Engineering (ICMSE) (pp. 137-143). IEEE.

Lin, B. W. (2004). Original equipment manufacturers (OEM) manufacturing strategy for network innovation agility: the case of Taiwanese manufacturing networks. *International Journal of Production Research*, 42(5), 943-957.

Lin, C. T., Chiu, H., & Tseng, Y. H. (2006). Agility evaluation using fuzzy logic. *International journal of production economics*, 101(2), 353-368.

Lin, C., Wu, Y. J., Chang, C., Wang, W., & Lee, C. Y. (2012). The alliance innovation performance of R&D alliances—the absorptive capacity perspective. *Technovation*, 32(5), 282-292.

Lippman, S. A., & Rumelt, R. P. (1982). Uncertain imitability: An analysis of interfirm differences in efficiency under competition. *The bell journal of Economics*, 418-438.

Liu, L., & Jiang, Z. (2016). Influence of technological innovation capabilities on product competitiveness. *Industrial Management & Data Systems*, 116(5), 883-902.

Lockett, A., Thompson, S., & Morgenstern, U. (2009). The development of the resource-based view of the firm: A critical appraisal. *International journal of management reviews*, 11(1), 9-28.

Lu, Y., & K. (Ram) Ramamurthy. (2011). Understanding the link between information technology capability and organizational agility: An empirical examination. *MIS quarterly*, 931-954.

Lumpkin, G. T., & Dess, G. G. (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. *Academy of management Review*, 21(1), 135-172.

Madhani, P. M. (2010). Resource based view (RBV) of competitive advantage: an overview. *Resource based view: concepts and practices*, Pankaj Madhani, ed, 3-22.

Mahoney, J. T. (2004). *Economic foundations of strategy*. Sage Publications.

Mathiyakalan, S., Ashrafi, N., Zhang, W., Waage, F., Kuilboer, J. P., & Heimann, D. (2005, May). Defining business agility: an exploratory study. In Proceedings of the 16th Information Resources Management Conference, San Diego, CA (pp. 15-18).

Matusik, S. F., & Hill, C. W. (1998). The utilization of contingent work, knowledge creation, and competitive advantage. *Academy of management review*, 23(4), 680-697.

Menor, L. J., Roth, A. V., & Mason, C. H. (2001). Agility in retail banking: a numerical taxonomy of strategic service groups. *Manufacturing & Service Operations Management*, 3(4), 273-292.

Miller, D., & Friesen, P. H. (1983). Strategy-making and environment: the third link. *Strategic management journal*, 4(3), 221-235.

Mortazavi Ravari, S. S., Mehrabanfar, E., Banaitis, A., & Banaitienė, N. (2016). Framework for assessing technological innovation capability in research and technology organizations. *Journal of Business Economics and Management*, 17(6), 825-847.

Mrugalska, B., & Ahmed, J. (2021). Organizational agility in industry 4.0: A systematic literature review. *Sustainability*, 13(15), 8272.

Mu, J., & Di Benedetto, C. A. (2011). Strategic orientations and new product commercialization: mediator, moderator, and interplay. *R&D Management*, 41(4), 337-359.

Nafei, W. A. (2016). Organizational agility: The key to organizational success. *International Journal of Business and Management*, 11(5), 296-309.

Najrani, M. (2016). The endless opportunity of organizational agility. *Strategic Direction*, 32(3), 37-38.

Nejatian, M., Zarei, M. H., Nejati, M., & Zanjirchi, S. M. (2018). A hybrid approach to achieve organizational agility: An empirical study of a food company. *Benchmarking: An International Journal*, 25(1), 201-234.

Nielsen, P., & Lundvall, B. Å. (2003). Innovation, learning organizations and industrial relations. Department of Business Studies, Univ.

Niu, K. H., & Li, H. (2022). Knowledge Management and Organizational Adaptation Effectiveness: An Empirical Study. *International Journal of Business Management and Commerce*, 7(1), 10-26.

OECD (2023), Enterprises by business size (indicator). doi: 10.1787/31d5eeaf-en (Accessed on 15 May 2023)

OECD Manual – online access (2013), <https://stats.oecd.org/glossary/detail.asp?ID=2688>

O'Regan, N., Ghobadian, A., & Sims, M. (2006). Fast tracking innovation in manufacturing SMEs. *Technovation*, 26(2), 251-261.

Organisation for Economic Cooperation and Development (OECD) (2002). Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development. Paris: OECD.

Overby, E., Bharadwaj, A., & Sambamurthy, V. (2006). Enterprise agility and the enabling role of information technology. *European Journal of Information Systems*, 15(2), 120-131.

Palmberg, C. (2004). The sources of innovations—looking beyond technological opportunities. *Economics of innovation and new technology*, 13(2), 183-197.

Panda, H., & Ramanathan, K. (1996). Technological capability assessment of a firm in the electricity sector. *Technovation*, 16(10), 561–588.

Panda, S., & Rath, S. K. (2016). Investigating the structural linkage between IT capability and organizational agility: A study on Indian financial enterprises. *Journal of Enterprise Information Management*, 29(5), 751-773.

Panda, S., & Rath, S. K. (2018). Information technology capability, knowledge management capability, and organizational agility: The role of environmental factors. *Journal of Management & Organization*, 1-27.

Pang, K. Y. (2021). Value Creation by Private Equity Firms: A Resource-Based View (Doctoral dissertation, University of Missouri-Saint Louis).

Park, Y., El Sawy, O. A., & Fiss, P. (2017). The role of business intelligence and communication technologies in organizational agility: a configurational approach. *Journal of the association for information systems*, 18(9), 1.

Park, Y., Yoon, B., & Lee, S. (2005). The idiosyncrasy and dynamism of technological innovation across industries: patent citation analysis. *Technology in Society*, 27(4), 471-485.

Penrose, E. T. (1959). *The Theory of the Growth of the Firm*. New York: John Wiley

Penrose, R. (1959, January). The apparent shape of a relativistically moving sphere. In *Mathematical Proceedings of the Cambridge Philosophical Society* (Vol. 55, No. 1, pp. 137-139). Cambridge University Press.

Perdomo-Ortiz, J., Gonzalez-Benito, J., & Galende, J. (2009). The intervening effect of business innovation capability on the relationship between Total Quality Management and technological innovation. *International Journal of Production Research*, 47(18), 5087-5107.

Peteraf, M. A. (1993). The cornerstones of competitive advantage: a resource-based view. *Strategic management journal*, 14(3), 179-191.

Piening, E.P. & Salge, T.O. (2015). Understanding the antecedents, contingencies and performance implications of process innovation: A dynamic capabilities perspective. *Journal of Product Innovation Management*, 32(1), 80-97.

Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2016). Recommendations for creating better concept definitions in the organizational, behavioral, and social sciences. *Organizational Research Methods*, 19(2), 159-203.

Porter, M. (1990). The competitive advantage of nations. *Harvard Business Review*, 68(2), 73-93.

Porter, M. E. (1994). The role of location in competition. *Journal of the Economics of Business*, 1(1), 35-40.

Prahalad, C.K. & Hamel, G. (1990). The core competence of the organization. *Harvard Business Review*, Vol. 68 No. 3, pp. 79-91.

Raeisi, N., & Amirnejad, Q. (2017). Investigating the effect of organizational leadership on organizational agility: Mediating role of organizational commitment. *Journal of Economic & Management Perspectives*, 11(1), 1154-1168.

Rafi, N., Ahmed, A., Shafique, I., & Kalyar, M. N. (2022). Knowledge management capabilities and organizational agility as liaisons of business performance. *South Asian Journal of Business Studies*, 11(4), 397-417.

Ramanujam, V., & Venkatraman, N. (1987). Planning system characteristics and planning effectiveness. *Strategic Management Journal*, 8(5), 453-468.

Ravichandran, T. (2018). Exploring the relationships between IT competence, innovation capacity and organizational agility. *The Journal of Strategic Information Systems*, 27(1), 22-42.

Rindova, V. P., & Kotha, S. (2001). Continuous “morphing”: Competing through dynamic capabilities, form, and function. *Academy of management journal*, 44(6), 1263-1280.

Rumelt, R. (1987). The Electronic Reorganisation of Industry. In *Global Management in the 80's Conference of the Strategic Management Society*, London in.

Rumelt, R. P. (1984). Towards a strategic theory of the firm. *Competitive strategic management*, 26(3), 556-570.

Rumelt, R. P. (1991). How much does industry matter?. *Strategic management journal*, 12(3), 167-185.

Rüßmann, M., Lorenz, M., Gerbert, P., Waldner, M., Engel, P., Harnisch, M. & Justus, J. (2015). Industry 4.0: The Future of Productivity and Growth in Manufacturing Industries. *BCG Publications*.
https://www.bcg.com/publications/2015/engineered_products_project_business_industry_4_future_productivity_growth_manufacturing_industries

Saha, N., Gregar, A., & Sáha, P. (2017). Organizational agility and HRM strategy: Do they really enhance firms' competitiveness?. *International Journal of Organizational Leadership*, 6, 323-334.

Sambamurthy, V., Bharadwaj, A., & Grover, V. (2003). Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms. *MIS quarterly*, 237-263.

Sambamurthy, V., Wei, K. K., Lim, K., & Lee, D. (2007). IT-enabled organizational agility and firms' sustainable competitive advantage. *ICIS 2007 proceedings*, 91.

Sambamurthy, V., Wei, K. K., Lim, K., & Lee, D. (2007). IT-enabled organizational agility and firms' sustainable competitive advantage. *ICIS 2007 proceedings*, 91.

Schilling, M. A. (2016). Strategic management of technological innovation. 5th ed. [P] [SEP] New York: McGraw-Hill/Irwin.

Schumpeter, J. A. (1934). The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle.

Shafia, M. A., Shavvalpour, S., Hosseini, M., & Hosseini, R. (2016). Mediating effect of technological innovation capabilities between dynamic capabilities and competitiveness of research and technology organisations. *Technology Analysis & Strategic Management*, 28(7), 811-826.

Shan, J., & Jolly, D. R. (2010). Accumulation of Technological Innovation Capability and Competitive Performance in Chinese Firms. *IAMOT*. Kahire.

Sharifi, H., & Zhang, Z. (1999). A methodology for achieving agility in manufacturing organisations: An introduction. *International journal of production economics*, 62(1-2), 7-22.

Sherehiy, B., Karwowski, W., & Layer, J. K. (2007). A review of enterprise agility: Concepts, frameworks, and attributes. *International Journal of industrial ergonomics*, 37(5), 445-460.

Siallagan, S., Silaban, R., & Ali, A. Y. (2019). Academic review on literatures pertaining to the definitions of technological innovation capabilities in the new millennium. In *IOP Conference Series: Materials Science and Engineering* (Vol. 505, No. 1, p. 012132). IOP Publishing.

Simon, A., Bartle, C., Stockport, G., Smith, B., Klobas, J.E. & Sohal, A. (2015). Business leaders' views on the importance of strategic and dynamic capabilities for successful financial and non-financial business performance. *International Journal of Productivity and Performance Management*, 64(7), 908-931.

Sindhwani, R., & Malhotra, V. (2017). A framework to enhance agile manufacturing system: a total interpretive structural modelling (TISM) approach. *Benchmarking: An International Journal*.

Singh, J., Sharma, G., Hill, J., & Schnackenberg, A. (2013). Organizational agility: What it is, what it is not, and why it matters. In *Academy of management proceedings* (Vol. 1, No. 1, pp. 1-40). Briarcliff Manor, NY 10510: Academy of Management.

Smith, K. (2005). 'Measuring Innovation', in J. Fagerberg, D. Mowery, and R. Nelson (eds.), *The Oxford Handbook of Innovation*. Oxford: Oxford University Press, pp. 148–79.

Subramaniam, M., & Youndt, M. A. (2005). The influence of intellectual capital on the types of innovative capabilities. *Academy of Management journal*, 48(3), 450-463.

Sumrit, D., & Anuntavoranich, P. (2013). Using DEMATEL method to analyze the causal relations on technological innovation capability evaluation factors in Thai technology-based firms. *International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies*, 4(2), 81-103.

Tallon, P. P., & Pinsonneault, A. (2011). Competing perspectives on the link between strategic information technology alignment and organizational agility: insights from a mediation model. *MIS quarterly*, 463-486.

Teece, D. J. (2018). Business models and dynamic capabilities. *Long range planning*, 51(1), 40-49.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic management journal*, 18(7), 509-533.

Teece, D., Peteraf, M., & Leih, S. (2016). Dynamic capabilities and organizational agility: Risk, uncertainty, and strategy in the innovation economy. *California management review*, 58(4), 13-35.

Teece, D.J. (2007). Explicating dynamic capabilities: The nature and micro foundations of (sustainable) enterprise performance. *Strategic Management Journal*, 28(13), 1319-1350.

Teece, D.J., Pisano, G. & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7): 509-533.

Triaa, W., Gzara, L., & Verjus, H. (2016, August). Organizational agility key factors for dynamic business process management. In 2016 IEEE 18th Conference on Business Informatics (CBI) (Vol. 1, pp. 64-73). IEEE.

Tseng, Y. H., & Lin, C. T. (2011). Enhancing enterprise agility by deploying agile drivers, capabilities and providers. *Information Sciences*, 181(17), 3693-3708.

Tseng, Y. H., & Lin, C. T. (2011). Enhancing enterprise agility by deploying agile drivers, capabilities and providers. *Information Sciences*, 181(17), 3693-3708.

Türker, M. V. (2012). A model proposal oriented to measure technological innovation capabilities of business firms—a research on automotive industry. *Procedia-social and behavioral sciences*, 41, 147-159.

Tushman, M. and Anderson, P. (1986). 'Technological Discontinuities and Organizational Environment', *Administrative Science Quarterly*, 31: 439–56.

Ullman, J. B., & Bentler, P. M. (2012). Structural equation modeling. *Handbook of Psychology*, Second Edition, 2.

Van Oosterhout, M., Waarts, E., & van Hillegersberg, J. (2006). Change factors requiring agility and implications for IT. *European journal of information systems*, 15(2), 132-145.

Velásquez, J. R., Zambrano, J. J. A., & Vélez, J. D. P. (2011, July). Methodological tool for measurement and assessment of technological innovation capabilities. In 2011 Proceedings of PICMET'11: Technology Management in the Energy Smart World (PICMET) (pp. 1-8). IEEE.

Velásquez, J. R., Zambrano, J. J. A., & Vélez, J. D. P. (2011, July). Methodological tool for measurement and assessment of technological innovation capabilities. In 2011 Proceedings of PICMET'11: Technology Management in the Energy Smart World (PICMET) (pp. 1-8). IEEE.

Voudouris, I., Lioukas, S., Iatrelli, M., & Caloghirou, Y. (2012). Effectiveness of technology investment: Impact of internal technological capability, networking and investment's strategic importance. *Technovation*, 32(6), 400-414.

- Walter, A. T. (2021). Organizational agility: ill-defined and somewhat confusing? A systematic literature review and conceptualization. *Management Review Quarterly*, 71, 343-391.
- Wang, C. H., Lu, I. Y., & Chen, C. B. (2008). Evaluating firm technological innovation capability under uncertainty. *Technovation*, 28(6), 349-363.
- Watkins, M. W. (2018). Exploratory factor analysis: A guide to best practice. *Journal of Black Psychology*, 44(3), 219-246.
- Wendler, R. (2013, September). The structure of agility from different perspectives. In *Computer Science and Information Systems (FedCSIS), 2013 Federated Conference on* (pp. 1177-1184). IEEE.
- Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic management journal*, 5(2), 171-180.
- Wernerfelt, B. (1989). From critical resources to corporate strategy. *Journal of general management*, 14(3), 4-12.
- Wilhelm, H., Schlömer, M. & Maurer, I. (2015). How dynamic capabilities affect the effectiveness and efficiency of operating routines under high and low levels of environmental dynamism. *British Journal of Management*, 26(2), 327-345.
- Winter, S.G. (2003). Understanding dynamic capabilities. *Strategic Management Journal*, 24(10), 991-995.
- Wójcik, P. (2015). Exploring links between dynamic capabilities perspective and resource-based view: A literature overview. *International Journal of Management and Economics*, 45(1), 83-107.
- Yam, R. C., Guan, J. C., Pun, K. F., & Tang, E. P. (2004). An audit of technological innovation capabilities in Chinese firms: some empirical findings in Beijing, China. *Research policy*, 33(8), 1123-1140.
- Yam, R. C., Lo, W., Tang, E. P., & Lau, A. K. (2011). Analysis of sources of innovation, technological innovation capabilities, and performance: An empirical study of Hong Kong manufacturing industries. *Research policy*, 40(3), 391-402.
- Yıldız, İ., Karaman, G. E., & Karaman, E. (2017). Bilişim Sistemleri Başarısı ve Örgütsel Atiklik: Sigorta Şirketleri Üzerine İlişkisel Çalışma. *Gazi Üniversitesi Sosyal Bilimler Dergisi*, 4(11), 421-444.
- Youssef, M. A. (1992). Agile manufacturing: a necessary condition for competing in global markets. *Industrial Engineering-New York Then Atlanta Norcross-American Institute of Industrial Engineers Incorporated*, 24, 18-18.
- Yusuf, Y. Y., Sarhadi, M., & Gunasekaran, A. (1999). Agile manufacturing:: The drivers, concepts and attributes. *International Journal of production economics*, 62(1-2), 33-43.
- Zahra, S. A., & Covin, J. G. (1995). Contextual influences on the corporate entrepreneurship-performance relationship: A longitudinal analysis. *Journal of business venturing*, 10(1), 43-58.

Zahra, S. A., & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of management review*, 27(2), 185-203.

Zahra, S.A., Sapienza, H.J. & Davidsson, P. (2006). Entrepreneurship and dynamic capabilities: A review, model and research agenda. *Journal of Management Studies*, 43(4), 917-955.

Zhang, H., & Zhou, B. (2007). The Research on Evaluation of Technological Innovation Capability Based on ANP. In *International Conference on Management Science and Engineering*.

Zhang, Z., & Sharifi, H. (2007). Towards theory building in agile manufacturing strategy—a taxonomical approach. *IEEE Transactions on Engineering Management*, 54(2), 351-370.

Zhou, K. Z., & Wu, F. (2010). Technological capability, strategic flexibility, and product innovation. *Strategic management journal*, 31(5), 547-561.

Zitkiene R., ve Deksnys, M. (2018), Organizational Agility Conceptual Model, *Montenegrin Journal of Economics*, 14(2), 115-129.

Zollo, M. & Winter, S.G. (2002). Deliberate learning and the evolution of dynamic capabilities. *Organization Science*, 13(3), 339-351.



APPENDIX A - QUESTIONNAIRE (TURKISH VERSION)

	Çalıştığınız firmayı dikkate alarak aşağıdaki ifadelere ne ölçüde katıldığınızı belirtiniz.					
	1.Kesinlikle Katılmıyorum 2.Katılmıyorum 3.Kararsızım 4.Katılıyorum 5. Kesinlikle Katılıyorum					
	Birinci Kısım					
1	Firmamızda teknolojik gelişme eğilimleri sistemli bir şekilde izlenir.	1	2	3	4	5
2	Firmamız kendi işletme stratejisiyle ilişkili teknolojileri değerlendirilebilir.	1	2	3	4	5
3	Firmamızda çalışma ekipleri gelişim fırsatlarını tespit etmeye teşvik edilir.	1	2	3	4	5
4	Firmamızda elde edilen bilgiler içselleştirilir.	1	2	3	4	5
5	Firmamızın teknolojik yeteneklerini pazar ihtiyaçlarıyla eşleştirmeye çalışırız.	1	2	3	4	5
6	Firmamızda deneyimlerden ders alınır.	1	2	3	4	5
7	Firmamızda alınan dersler sınırların ve zamanın ötesine taşınır.	1	2	3	4	5
8	Firmamızda öğrenme bilinci kazandırılır ve öğrenmeye yatırım yapılır.	1	2	3	4	5
9	Firmamızda örtülü (deneyimle öğrenilen) bilgilere dikkat edilir.	1	2	3	4	5
10	Firmamızda yaratıcılığı ve yenilikçiliği teşvik eden ve ödüllendiren mekanizmalar vardır.	1	2	3	4	5
11	Firmamızın Ar-Ge planları, kurumsal planla uyumlu olarak hazırlanır.	1	2	3	4	5
12	Firmamızda farklı departmanlar konsept geliştirme çalışmaları için fikir alışverişi yaparlar.	1	2	3	4	5
13	Firmamızda proje hedefleri, proje safhalarının standartları ve proje yönetimi düzenlemeleri açıkça belirlenir.	1	2	3	4	5
14	Firmamızda departmanlar arası takım çalışması yapılır.	1	2	3	4	5
15	Firmamızdaki ürün sorumluları ulaşılabilir kalifiye elemanlardır.	1	2	3	4	5
16	Firmamızda Ar-Ge personeli etkin bir şekilde iletişim halindedir.	1	2	3	4	5
17	Firmamızda değişim mühendisliği (reengineering) gibi ileri düzey tasarım yöntemleri uygulanır.	1	2	3	4	5
18	Firmamızda yenilik sürecinde farklı departmanlardan gruplar birlikte çalışırlar.	1	2	3	4	5
19	Tasarım ve mühendislik birimine üretim biriminden gelen geri bildirimler hızlı ve kalitelidir.	1	2	3	4	5
20	Firmamızda teknolojiyi araştırma aşamasından geliştirme aşamasına aktaracak mekanizmalar bulunmaktadır.	1	2	3	4	5

21	Firmamızda imalat için tasarım veya müşteri kullanımı için tasarım gibi belirli protokoller bulunur.	1	2	3	4	5
22	Firmamızın yenilik süreci, pazarın ve müşterilerin geri bildirimlerini de kapsar.	1	2	3	4	5
23	Firmamızda yeni ürünlere Ar-Ge yatırımı yapılır.	1	2	3	4	5
24	Firmamızda yeni süreçlere Ar-Ge yatırımı yapılır.	1	2	3	4	5
25	Firmamızda yıllık ortalama hayata geçirilen proje sayısı yüksektir.	1	2	3	4	5
26	Firmamızın toplam istihdamının içinde Ar-Ge personeli yüzdesi yüksektir.	1	2	3	4	5
27	İşletmemizde, çalışanlar önemli bir kaynak olarak kabul edilir.	1	2	3	4	5
28	İşletmemizde insan kaynakları aşamalar halinde planlanır.	1	2	3	4	5
29	İşletmemiz, inovasyon sürecinde her fonksiyonel departman için uygun olan personeli seçebilir.	1	2	3	4	5
30	İşletmemizde, inovasyon aktiviteleri için istikrarlı sermaye destekleri verilir.	1	2	3	4	5
31	İşletmemizdeki sermaye kaynaklarında esneklik ve çeşitlilik vardır.	1	2	3	4	5
32	İşletmemizde inovasyon maliyetlerini azaltmak için işbirlikçi inovasyon yöntemleri uygulanır.	1	2	3	4	5
33	İşletmemizde tamamiyle dışarıdan alınmış teknolojiler kullanılmaktadır.	1	2	3	4	5
34	İşletmemiz, rakip firmaların temel teknolojileri hakkında bilgi sahibidir.	1	2	3	4	5
35	İşletmemiz teknoloji seviyesini, dış çevrede oluşan değişimlere göre adapte edebilir.	1	2	3	4	5
36	İmalat departmanımız, inovasyon sürecindeki konsept tasarımı aşamasına büyük ölçüde katkı sağlar.	1	2	3	4	5
37	İmalat departmanımız Ar&Ge çıktılarını üretime dönüştürme yeteneğine sahiptir.	1	2	3	4	5
38	İşletmemizdeki ekipmanlar geniş ölçüde teknik yetkinliğe sahiptir.	1	2	3	4	5
39	İşletmemiz, gelişmiş imalat yöntemlerini etkin bir biçimde uygular.	1	2	3	4	5
40	İşletmemiz, yetkin imalat personeline sahiptir.	1	2	3	4	5
41	İşletmemiz, imalat sistemini devamlı olarak geliştirmede büyük ölçüde etkindir.	1	2	3	4	5
42	İşletmemiz, kapsamlı kalite kontrole üst düzey önem vermektedir.	1	2	3	4	5
43	İşletmemizde yapılan imalatların maliyetinde üst düzey bir avantaj söz konusudur.	1	2	3	4	5

44	İşletmemizin imalat birimine yapılan yatırım miktarı satışlardan kazanılan toplam getiriler ile orantılıdır.	1	2	3	4	5
45	İşletmemizde, büyük müşterilerle ilişki yönetimi sağlanmaktadır	1	2	3	4	5
46	İşletmemizde farklı pazar segmentlerine dair bilgi edinilir	1	2	3	4	5
47	İşletmemizde pazarlama bilgi sistemleri verimli bir şekilde kullanılmaktadır	1	2	3	4	5
48	İşletmemizde pazarlama bilgileri verimli şekilde sunulur	1	2	3	4	5
49	İşletmemizde etkin bir dağıtım sistemi bulunur	1	2	3	4	5
50	İşletmemiz etkin bir satış ekibine sahiptir	1	2	3	4	5
51	İşletmemizin satış sonrası hizmet performansı iyidir	1	2	3	4	5
52	İşletmemizde müşteri memnuniyet düzeyi izlenmektedir	1	2	3	4	5
53	İşletmemizin marka imajı ve kurumsal imajı korunur.	1	2	3	4	5
54	İşletmemiz örgüt yapısını esnek bir şekilde yeniden düzenleyebilir.	1	2	3	4	5
55	İşletmemizdeki her alt birim özerk olarak çalışabilir.	1	2	3	4	5
56	İşletmemizde eş zamanlı olarak birden fazla inovasyon projesi idare edilebilir.	1	2	3	4	5
57	İşletmemizde Ar&Ge, pazarlama ve imalat departmanları arasında iyi bir koordinasyon ve işbirliği mevcuttur.	1	2	3	4	5
58	İşletmemizde ana tedarikçiler ve ana müşteriler ile iyi bir iletişim kurulmuştur.	1	2	3	4	5
59	İşletmemiz ana fonksiyonel departmanların üst-düzey entegrasyonunu ve kontrolünü sağlayabilir.	1	2	3	4	5
60	İşletmemiz inovasyon projelerinin ilerlemelerini takip amaçlı etkili yöntemlere sahiptir.	1	2	3	4	5
61	İşletmemizde acil durumlarda yapılacaklar planlanmıştır	1	2	3	4	5
62	İşletmemizin güçlü ve zayıf yönleri tespit edilmeye çalışılır	1	2	3	4	5
63	İşletmemizde dışsal fırsat ve tehditler tespit edilmeye çalışılır	1	2	3	4	5
64	İşletmemizde hedef net olarak ifade edilir	1	2	3	4	5
65	İşletmemizde ölçülebilir kademelere ayrılmış bir yol haritası şeklinde net bir plan mevcuttur	1	2	3	4	5
66	İşletmemizin dış çevreye adaptasyonu ve yanıt verebilmesi sağlanmıştır	1	2	3	4	5
	Çalıştığınız firmayı dikkate alarak aşağıdaki ifadelere ne ölçüde katıldığınızı belirtiniz.					
	1.Kesinlikle Katılmıyorum 2.Katılmıyorum 3.Kararsızım 4.Katılıyorum 5. Kesinlikle Katılıyorum					
	İkinci Kısım					

67	Firmamız, yeni iş fırsatlarını önceden tespit etmekte başarılıdır.	1	2	3	4	5
68	Firmamız, yeni iş fırsatlarını araştırır.	1	2	3	4	5
69	Firmamız, pazarın gelecekteki ihtiyaçları için özgün yaklaşımlarda bulunur.	1	2	3	4	5
70	Firmamız, yüksek getiri ihtimali olan yüksek-riskli projeleri araştırır.	1	2	3	4	5
71	Firmamız, getirisi kesin olmasa dahi sektörel deneyimlemeleri destekler.	1	2	3	4	5
72	Firmamız, pazarı ve rekabeti değiştirme potansiyeli olan radikal değişikliklere kaynak bağlamaktan çekinmez.	1	2	3	4	5
73	Firmamız, müşteri ihtiyaçları ile ilgili ortaya çıkan fırsatlara süratle tepki verip, değerlendirir.	1	2	3	4	5
74	Firmamız, Pazar ile ilgili ortaya çıkan fırsatlara süratle tepki verip, değerlendirir.	1	2	3	4	5
75	Firmamız, yeni ürün ve hizmetler ile ilgili ortaya çıkan fırsatlara süratle tepki verip, değerlendirir.	1	2	3	4	5
76	Firmamız, mevcut iş modellerine uyum sağlar.	1	2	3	4	5
77	Firmamız, mevcut iş süreçlerine uyum sağlar.	1	2	3	4	5
78	Firmamız, diğer firmalar tarafından kullanılan en iyi uygulamaları benimser.	1	2	3	4	5
Üçüncü Kısım						
79	Cinsiyetiniz: ☐ Kadın ☐ Erkek					
80	Yaşınız:					
81	Eğitim Durumunuz: ☐ Lise ☐ Önlisans ☐ Lisans ☐ Yüksek Lisans ☐ Doktora					
82	Firmadaki Pozisyonunuz: ☐ Firma Sahibi ☐ Genel Müdür ☐ Departman Müdürü: _____ (Departman İsmi)					
	☐ Proje Yöneticisi ☐ Şef ☐ Takım Sorumlusu ☐ Diğer: _____					
83	Bu Firmadaki Çalışma Süreniz:					
84	Çalıştığınız Firmanın Faaliyet Gösterdiği Sektör:					
	☐ Bilgisayar ve İletişim Teknolojileri ☐ Dayanıklı Tüketim Malları ☐ Demir ve Demir Dışı Metaller					
	☐ Elektrik-Elektronik ☐ Enerji ☐ Gıda ☐ İklimlendirme ☐ İlaç ☐ Kimya ☐ Makine ve Teçhizat İmalatı					
	☐ Otomotiv ☐ Otomotiv Yan Sanayi ☐ Plastik-Kauçuk ☐ Sağlık ☐ Savunma Sanayi					
	☐ Tekstil ☐ Telekomünikasyon ☐ Ulaştırma ve Lojistik ☐ Yazılım					

	☐ Diğer: _____					
85	Firmadaki Toplam Çalışan Sayısı: _____					
86	Firmanızın Ar&Ge Merkezi olarak hizmet verdiği toplam süre: _____					
87	Firmanızın Devam Eden Proje Sayısı: _____					
88	Firmanızın Tamamlanmış Proje Sayısı: _____					





APPENDIX B – SURVEY INSTRUMENTS AND REMOVED ITEMS

Table 32 – Items of Technological Innovation Capabilities Instrument and the Labels Used in the Analyses

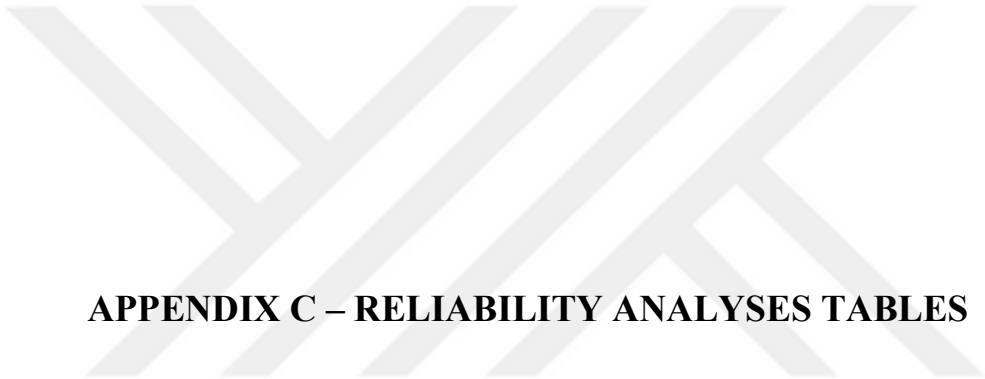
Item Statement	Item Label
Learning capability	
Systematically monitoring technology development trends.	LC1
Capacity to assess technologies relevant to firm's business strategy.	LC2
<i>Work teams encouraged to identify opportunities for improvement.*</i>	LC3
<i>Assimilating acquired knowledge.*</i>	LC4
Understanding firm's core competencies and matching technological capabilities to market needs.	LC5
Learning the lessons of experiences.	LC6
Passing lessons learned across boundaries and time.	LC7
Cultivating learning readiness and investing on learning.	LC8
<i>Paying attention to tacit acknowledge.*</i>	LC9
R&D Capability	
Mechanisms to encourage and reward inventiveness and creativity.	RDC1
<i>Relevance of R&D plan to the corporate plan.*</i>	RDC2
<i>Range of functions (departments) involved in concept development and screening.*</i>	RDC3
Clear project targets, project phase standards and project managing regulations.	RDC4
<i>Presence of Cross-functional teamwork.*</i>	RDC5
<i>Quality and availability of product champions.*</i>	RDC6
<i>Efficiency of R&D personnel communication.*</i>	RDC7
<i>Application of advanced designing methods, such as reengineering.*</i>	RDC8
<i>Level of integration between different functional groups in the innovation process.*</i>	RDC9
Quality and speed of feedback from manufacturing to design and engineering.	RDC10
<i>Mechanisms for transferring technology from research to development.*</i>	RDC11
<i>Presence of established protocols such as design for manufacture, design for customer use.*</i>	RDC12
<i>Extent of market and customer feedback into the innovation process.*</i>	RDC13
Level of R&D investment in new products.	RDC14
Level of R&D investment in new processes.	RDC15
<i>Average number of live projects per year.*</i>	RDC16

<i>R&D personnel as percentage of the firm's total employment.*</i>	RDC17
Resource Allocation Capability	
Attaching importance to human resource.	RAC1
Programming human resource in phases.	RAC2
<i>Selecting key personnel in each functional department.*</i>	RAC3
Steady capital supplement in innovation activity.	RAC4
Flexibility and diversity of capital origins.	RAC5
<i>Cooperative innovation to reduce innovation cost.*</i>	RAC6
<i>Making fully use of external technologies.*</i>	RAC7
<i>Understanding competitors core technology competence.*</i>	RAC8
<i>Adapting self-technology level according to changes in the external environment.*</i>	RAC9
Manufacturing Capability	
Contribution of the manufacturing department during the initial phase of the innovation process.	MNC1
Ability to comply with the requests of R&D.	MNC2
Overall technical capability of equipment.	MNC3
Effectiveness of applications of the state of the art manufacturing methods.	MNC4
Capability of manufacturing personnel.	MNC5
Extent which continuous improvement of the manufacturing system is in place.	MNC6
Level of importance attached to overall quality control.	MNC7
<i>Degree of manufacturing cost advantage.*</i>	MNC8
<i>Investment in manufacturing as a percentage of sales (last 3 years average).*</i>	MNC9
Marketing Capability	
Relationship management with major customers.	MKC1
Knowledge of different market segments.	MKC2
Effectiveness of the marketing intelligence system.	MKC3
Effectiveness of marketing information dissemination.	MKC4
Distribution efficiency.	MKC5
Sales-force efficiency.	MKC6
<i>Performance of after-sales services.*</i>	MKC7
<i>Tracking customer satisfaction level.*</i>	MKC8
<i>Maintenance of brand image and corporate image.*</i>	MKC9
Organizing Capability	

Flexibility in adjusting the organization structure.	OC1
Autonomy of sub-units.	OC2
Ability to handle multiple innovation projects in parallel.	OC3
<i>Coordination and cooperation of R&D, marketing and manufacturing.*</i>	OC4
<i>Communication between suppliers, company and major customers.*</i>	OC5
<i>High-level integration and control of the major functions with the company.*</i>	OC6
<i>Mechanisms to track progress of innovation projects.*</i>	OC7
Strategy Planning Capability	
<i>The extent of contingency thinking and planning.*</i>	SPC1
<i>Ability to identify internal strengths and weaknesses.*</i>	SPC2
<i>Ability to identify external opportunities and threats.*</i>	SPC3
Goal clarity.	SPC4
Availability of a clear plan—a road map with measurable milestones.	SPC5
<i>Adaptability and responsiveness of the company to external environment.*</i>	SPC6
*Starred and italic written items represent the removed items with low factor loadings in the Exploratory Factor Analyses	

Table 33 – Items of Organizational Agility Instrument and the Labels Used in the Analyses

Item Statement	Item Labels
Proactiveness	
Our organization anticipates new business opportunities.	PRO1
Our organization seeks new business opportunities.	PRO2
Our organization seeks novel approaches to future market needs.	PRO3
Radicalness	
Our organization seeks high-risk projects with chances of high return.	RAD1
Our organization supports business experimentation despite uncertain returns.	RAD2
Our organization commits resources to radical changes that can potentially transform markets and competition.	RAD3
Responsiveness	
Our organization rapidly reacts to emerging opportunities in customer needs.	RES1
Our organization rapidly reacts to emerging opportunities in markets.	RES2
Our organization rapidly reacts to emerging environmental opportunities (e.g., new regulations, globalization).	RES3
Adaptiveness	
Our organization adapts existing business models.	ADP1
Our organization adapts the existing business process.	ADP2
<i>Our organization quickly adopts best practices used by others.*</i>	ADP3
*Starred and italic written items represent the removed items with low factor loadings in the Exploratory Factor Analyses	



APPENDIX C – RELIABILITY ANALYSES TABLES

Table 34 – Item-Total Statistics for Manufacturing Capability				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
MNC1	29,58	22,037	,712	,908
MNC2	29,45	22,229	,767	,903
MNC3	29,36	22,883	,706	,908
MNC4	29,62	22,004	,732	,906
MNC5	29,52	22,658	,740	,906
MNC6	29,41	22,243	,770	,903
MNC7	29,28	22,574	,746	,905
RDC10	29,61	22,690	,651	,913

Table 35 – Item-Total Statistics for Marketing Capability				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
MNC1	29,58	22,037	,712	,908
MNC2	29,45	22,229	,767	,903
MNC3	29,36	22,883	,706	,908
MNC4	29,62	22,004	,732	,906
MNC5	29,52	22,658	,740	,906
MNC6	29,41	22,243	,770	,903
MNC7	29,28	22,574	,746	,905
RDC10	29,61	22,690	,651	,913

Table 36 – Item-Total Statistics for HR Planning Capability				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
MNC1	29,58	22,037	,712	,908
MNC2	29,45	22,229	,767	,903
MNC3	29,36	22,883	,706	,908
MNC4	29,62	22,004	,732	,906
MNC5	29,52	22,658	,740	,906
MNC6	29,41	22,243	,770	,903
MNC7	29,28	22,574	,746	,905
RDC10	29,61	22,690	,651	,913

Table 37 – Total Statistics for R&D Investment Capability				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
MNC1	29,58	22,037	,712	,908
MNC2	29,45	22,229	,767	,903
MNC3	29,36	22,883	,706	,908
MNC4	29,62	22,004	,732	,906
MNC5	29,52	22,658	,740	,906
MNC6	29,41	22,243	,770	,903
MNC7	29,28	22,574	,746	,905
RDC10	29,61	22,690	,651	,913

Table 38 – Item-Total Statistics for Technology Learning Capability				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
LC1	8,88	1,444	,622	,681
LC2	8,69	1,714	,672	,641
LC5	8,71	1,630	,548	,760

Table 39 – Item-Total Statistics for Organizing Capability				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
OC1	8,57	2,045	,601	,704
OC2	8,59	2,054	,649	,643
OC3	8,26	2,577	,587	,723

Table 40 – Item-Total Statistics for Experiential Learning Capability				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
LC6	4,16	,722	,716	.
LC7	4,45	,593	,716	.

**APPENDIX D – DISSERTATIONS LIST REGARDING AGILITY
STUDIES IN TURKEY**

Table 41 – Dissertations Prepared in Turkey Regarding the Concept of Agility by Year				
Author	Year	Type	Name	Type of Agility
Hüseyinov	2010	Master's Thesis	The role of organizational agility on strategic human resource management	Organizational Agility
Karalar	2015	PhD Thesis	The effect of reward management on organizational identification and workforce agility and a research	Workforce Agility
Sağbaş	2015	PhD Thesis	The impact of information technologies, agility and integration on operational and financial performance in supply chain management	Supply Chain Agility
Araza	2015	PhD Thesis	The effect of environmental dynamism to organizational agility and performance relationship	Organizational Agility
Hamad	2016	PhD Thesis	The impact of organizational agility and organizational learning capability on competitive intelligence	Organizational Agility
Şahin	2017	Master's Thesis	The role of supply chain agility in the effect of supply chain capability on firm performance	Supply Chain Agility
Özbay	2017	Master's Thesis	A research of relationship between organizational cynicism and workforce agility	Workforce Agility
Gündoğan	2017	Master's Thesis	Proposal of a new approach for measuring supplier agility: An application in automotive industry	Supply Chain Agility
Güner	2018	Master's Thesis	The impact of supply chain agility on firm performance and technology uncertainty	Supply Chain Agility
Sucu	2018	PhD Thesis	The effect of the high performance work system on organizational agility: a research in ground handling companies operating in the civil aviation industry	Organizational Agility
Boyacıoğulları	2018	Master's Thesis	The effect of supply chain operations agility on purchasing: A research on B2B businesses in istanbul	Supply Chain Agility
Fırat	2018	PhD Thesis	Organizational agility: Nexus Maturity Model for project organizations	Organizational Agility
Koçu	2018	PhD Thesis	Business-it alignment effects on business agility	Organizational Agility

Akkaya	2018	PhD Thesis	The effect of leadership style in techno-enterprise firms on firms' organizational agility: A research on Technoparks companies	Organizational Agility
Coşkun	2019	Master's Thesis	The effect of organizational knowledge sharing and organizational agility on competitive advantage	Organizational Agility
Basrı	2019	Master's Thesis	An investigation of the relationship between organization culture and organizational agility with Structural Equality Model: Kırşehir provincial sample	Organizational Agility
Reisoğlu	2019	Master's Thesis	Application of supplier selection in the air conditioning sector by using agility criterias and TOPSİS method	Supply Chain Agility
Şen	2020	PhD Thesis	Innovative organizational climate in the relationship of strategic agility and internal entrepreneurial behavior: A research in the aviation sector	Strategic Agility
Paçacı	2020	Master's Thesis	A research: Understanding the relationship between absorptive capacity and strategic agility	Strategic Agility
Özdemir	2020	PhD Thesis	A research on the impact of hrm practises' efficiency on organizational resilience and agility	Organizational Agility
Gözcü	2020	Master's Thesis	Relationship between organizational agility and organizational cynicism: An investigation on university employees	Organizational Agility
Beşli	2021	PhD Thesis	Agile transformation in a software company: The role of sensing in organizational agility	Organizational Agility
Bölükbaşı	2021	PhD Thesis	A research on the relationship between export marketing approach, marketing agility, export marketing capabilities, organizational structures of business and export performance	Marketing Agility
Över	2021	Master's Thesis	In companies; The relationship between agility perception, corporate culture, employee motivation, innovation and employee feedback	Organizational Agility
Tarakcı	2021	Master's Thesis	The mediating role of organizational commitment in the relationship between organizational agility and turnover intention	Organizational Agility

Eyüboğlu	2021	Master's Thesis	The meditation role of service orientation in the effect of logistics capabilities upon supply chain agility: An application on enterprises operating in the logistics sector	Supply Chain Agility
Damar	2021	PhD Thesis	Organizational ambidexterity and agility in SMEs: Cross-cultural comparison	Organizational Agility
Özkan	2021	Master's Thesis	The mediating role of innovation orientation in the effect of organizational agility on sustainable quality perception	Organizational Agility
Güneş	2021	Master's Thesis	Investigation of the effect of perception of the manager as a leader on organizational agility and information sharing within the organization	Organizational Agility
Çelik	2021	Master's Thesis	The effect of organizational ambidexterity on organizational agility	Organizational Agility
Küsen	2021	Master's Thesis	The effects of organizational agility on employee satisfaction and organizational commitment	Organizational Agility
Nazif	2022	Master's Thesis	The effect of leadership styles during the strategy development process and environmental conditions on organizational agility	Organizational Agility
Pampal	2022	Master's Thesis	The impact of strategic innovation management practices and organizational agility on organizational performance during the pandemic: A research on medical sector in Ankara	Organizational Agility
Chawk	2022	Master's Thesis	The impact of organizational agility dimensions on employees' job satisfaction in private universities in Lebanon	Organizational Agility
Demirbanka Afşar	2022	PhD Thesis	The mediation role of work engagement in the effect of strategic agility on innovative work behavior: A research in the automotive industry	Strategic Agility
Bunyatov	2022	Master's Thesis	The relationship between channel integration and performance in the retail industry in the covid-19 pandemic: The mediating role of strategic agility	Strategic Agility
Aydın	2022	Master's Thesis	The effects of learning orientation and employee empowerment on organizational agility: A research in logistics sector	Organizational Agility
Şentürk	2022	Master's Thesis	Impact of business continuity management system on strategic agility of enterprises: Research on Kardemir A.Ş.	Strategic Agility

Yalın	2022	Master's Thesis	The impact of digital leadership on organizational agility in the crisis environment caused by the covid-19 pandemic: A case study in a higher education institution	Organizational Agility
Batıbeyi	2022	Master's Thesis	The effect of strategic agility and competitive intelligence on company entrepreneurship: A research on medium and large enterprises operating in TRA1 level 2 region	Strategic Agility
Çelik	2022	Master's Thesis	The effect of digitalization of SME's on organizational agility	Organizational Agility
Ünsal	2022	PhD Thesis	Investigation of the effects of organizational ambidexterity and digital transformation on competitive advantage under the moderating roles of strategic agility and environmental hostility in SMEs	Strategic Agility
Yıkılmaz	2022	PhD Thesis	Investigation of the relations of large and small businesses with organizational agility and innovation	Organizational Agility
Kavakcı	2022	Master's Thesis	The effect of information technologies use on supply chain agility: Malatya province Organized Industrial Zone example	Supply Chain Agility
Demirkıran	2022	Master's Thesis	The mediating role of organizational learning in the relationship between organizational intelligence and organizational agility	Organizational Agility
Bilgetürk	2022	PhD Thesis	Big data analytics capability and firm performance: The mediating role of strategic agility and business model innovation	Strategic Agility
Ercan	2022	Master's Thesis	Prioritization of agility enablers to follow in logistics process design for agile SUPPLY chains: Perspective of both of manufacturer and logistics service provider	Supply Chain Agility
Salman	2022	Master's Thesis	The effects of organizational agility on organizational citizenship behaviors via the mediating role of perceived motivational climate	Organizational Agility

Source: Council of Higher Education – Thesis Center (tez.yok.gov.tr, 2022)