INVESTIGATING ORGANIZATIONAL AGILITY OF THE TURKISH CONSTRUCTION COMPANIES

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Submitted to the Institute for Graduate Studies in
Science and Engineering in partial fulfillment of
the requirements for the degree of
Master of Science

Graduate Program in Civil Engineering
Boğaziçi University
2021

ACKNOWLEDGEMENTS

Firstly, I am grateful to my thesis advisor Prof. Beliz Özorhon for her guidance, advice, and support in this process. Her vision and expertise in the construction research gave me a chance to investigate an important and interesting topic in the construction industry. Her valuable ideas and direction helped me to develop and improve the thesis study.

I would like to appreciate the help and support of Demet Demirer in the study. She is ambitious to integrate agility into the construction industry and is working to develop the industry. I would like to thank Tolga Erpınar and Dr. Volkan Ezcan for giving their valuable ideas helping to improve the study.

I would like to acknowledge the efforts of my professors from Boğaziçi University and Gebze Technical University, my colleagues from Gebze Technical University, several professionals from the construction industry, and my friends for their help in data collection. I would like to appreciate all respondents who took part in the questionnaire survey for helping us to reach a high amount of data with their voluntary participation.

I would like to express my endless thanks to my parents and my brother who have always supported and encouraged me in my education, career, and life. Their unconditional love and trust gave me strength. My parents have worked hard to give us the life that they think we deserve. They showed us the importance of being on the right way. Without them, I would not be the same person as I am.

I would like to thank my friends Ceren Nur Saygın, Elifsu Balcı, Yasemin Can, Bilgecan Cihan and Berke Kaan Ülgen for their sincere friendship, support, and help throughout the years. I would like to express my appreciation to the community of "BUSOS Yel Değirmeni" which I feel lucky to be a part of, for creating a safe place with real emotions. Last but not least, I would also like to thank Yusuf Tevetoğlu for his unconditional love, never-ending support, respect, patience and for always being there for me in good times and in bad times. He always believed in me and gave me courage.

ABSTRACT

INVESTIGATING ORGANIZATIONAL AGILITY OF THE TURKISH CONSTRUCTION COMPANIES

Today's business environment is complex, dynamic, and uncertain with increasing globalization, extreme competitiveness, developing technologies, and changing stakeholder needs. Companies need to sense the change and respond appropriately to survive, to sustain as an operable entity, and to become successful. Agility is a significant concept that helps organizations to survive and to stay competitive in an unpredictable and rapidly changing environment. Agility was founded and developed in the manufacturing and information systems industries. Although agility is at an early stage in the construction industry, it has potential. The existing literature of the construction industry mainly focuses on agile project management and supply chain agility, while organizational agility research is very limited. Considering this research gap, this study aims to investigate organizational agility of Turkish construction companies. A conceptual model was developed based on an in-depth literature review and interviews. In the model, organizational agility (sensing, responsiveness, flexibility, competency), environmental changes which act as agility drivers (political, economic, social, technological, environmental, legal changes, the threat of new entrants, rivalry among competitors), and organizational agility enablers (flat structure, change culture, organizational learning, people, technology, external relations) were considered. To test the relations in the model, the data were collected from practitioners working in Turkish construction companies through an online questionnaire survey. The collected data were analyzed using structural equation modeling. According to analysis results, change culture was found to have both direct and indirect positive effects on organizational agility. External relations were found to affect organizational agility positively. Organizational learning was found to affect organizational agility indirectly through the mediating role of people and technology, rather than directly. While the direct effect of the flat organizational structure on organizational agility was found to be negative, its indirect effect was positive through the mediatory role of human resources. Further, considering other research findings, theoretical, and practical contributions of the study were implied.

ÖZET

TÜRK İNŞAAT ŞİRKETLERİNİN ÖRGÜTSEL ÇEVİKLİĞİNİN İNCELENMESİ

Günümüzün iş dünyası; artan küreselleşme, aşırı rekabet gücü, gelişen teknolojiler ve değişen paydaş gereksinimleri ile karmaşık, dinamik ve belirsiz hale gelmiştir. Şirketlerin ayakta kalabilmek, varlıklarını sürdürebilmek ve başarı sağlayabilmek için değişimi sezmesi ve uygun şekilde yanıt vermesi gerekmektedir. Çeviklik, öngörülemeyen ve hızla değişen bir ortamda kuruluşların ayakta kalmalarına ve rekabetçi olmalarına yardımcı olan önemli bir kavramdır. Çeviklik kavramının temelleri üretim ve bilgi sistemleri sektörlerinde atılmış ve geliştirilmiştir. Çeviklik inşaat sektöründe henüz erken bir aşamada olsa da geliştirilme potansiyeline sahiptir. İnşaat sektörü ile ilgili mevcut literatüre bakıldığında, çalışmalar temel olarak çevik proje yönetimi ve çevik tedarik zincirine odaklanmakta, örgütsel çeviklik ile ilgili araştırmalar epey sınırlı kalmaktadır. Tez çalışması, literatürdeki çalışmaların eksikliği ve yetersizliğini dikkate alarak, Türk inşaat şirketlerindeki örgütsel çevikliği araştırmayı amaçlamaktadır. Yapılan geniş kapsamlı literatür taraması ve mülakatlar doğrultusunda kavramsal bir model geliştirilmiştir. Modelde, örgütsel çeviklik (algılama, tepki verme, esneklik, yetkinlik), çevikliğe neden olan çevresel değişiklikler (politik, ekonomik, sosyal, teknolojik, çevresel, yasal değişiklikler, pazara yeni giriş tehdidi, rakipler arasındaki rekabet), ve örgütsel çeviklik kolaylaştırıcıları (yatay örgüt yapısı, değişim kültürü, örgütsel öğrenme, insan, teknoloji, dış ilişkiler) dikkate alınmıştır. Modeldeki ilişkileri test etmek için veriler Türk inşaat şirketleri çalışanlarından çevrimiçi bir anket yoluyla toplanmıştır. Toplanan veriler yapısal eşitlik modellemesi metodu kullanılarak analiz edilmiştir. Analiz sonuçlarına göre, değişim kültürünün örgütsel çevikliği hem doğrudan hem de dolaylı olarak olumlu etkilediği görülmüştür. Dış ilişkilerin örgütsel çeviklik üzerinde olumlu etkisi görülmüştür. Örgütsel öğrenmenin, örgütsel çevikliği doğrudan değil, insan ve teknolojinin aracı rolüyle dolaylı olarak etkilediği bulunmuştur. Yatay örgüt yapısının örgütsel çeviklik üzerindeki doğrudan etkisi olumsuz iken, insan kaynaklarının aracı rolü olduğunda, dolaylı etkisinin olumlu olduğu bulunmuştur. Diğer araştırma çıktıları da düşünülerek, çalışmanın teorik ve pratik katkılarından bahsedilmiştir.

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LIST OF SYMBOLS

$\chi 2$	Chi-square

LIST OF ABBREVIATIONS

ADF	Asymptotically Distribution Free
AGFI	Adjusted Goodness-of-Fit Index
AHP	Analytical Hierarchy Process
AMOS	Analysis of MOment Structures
ANN	Artificial Neural Network
ASCTM	Agile Supply Chain Transformation Matrix
AVE	Average Variance Extracted
BSC	Balance Scorecard
CALIS	Covariance Analysis of LInear Structural equations
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
COVID-19	COronaVIrus Disease
cr	Critical Ratio
CSF	Critical Success Factor
df	Degrees of Freedom
ECDC	European Centre for Disease prevention and Control
EFA	Exploratory Factor Analysis
EQS	EQuationS
GCR	Global Competitiveness Report
GDP	Gross Domestic Product
GFI	Goodness-of-Fit Index
GII	Global Innovation Index
GLS	Generalized Least Squares
H	Hypothesis
HOQ	House Of Quality
IFI	Incremental Fit Index
ISM	Interpretive Structural Model
IT	Information Technology
KPI	Key Performance Indicators
lavaan	LAtent VAriable Analysis

LISREL	LInear Structural RELations
LM	Lagrange Multiplier
MCDM	Multiple-Criteria Decision Making
MI	Modification Index
ML	Maximum Likelihood
NFI	Normed Fit Index
NNFI	Non-Normed Fit Index
PESTEL	Political, Economic, Social, Technological, Environmental, Legal
PLS	Partial Least Squares
QFD	Quality Function Deployment
RMSEA	Root Mean Square Error of Approximation
SE	Standard Error
SEPATH	Structural Equations and PATH analysis
SPSS	Statistical Package for Social Science
SRMR	Standardized Root Mean Square Residual
TL	Turkish Lira
TLI	Tucker–Lewis Index
TOPSIS	Technique for Order of Preference by Similarity to Ideal Solution
ULS	Unweighted Least Squares
US	United States
VIF	Variance Inflation Factor
WHO	World Health Organization
WLS	Weighted Least Squares

1. INTRODUCTION

In the past, time, cost, and quality criteria were satisfactory for achieving success (Seethamraju, 2006). However, in today's business world, most organizations are challenging with globalization, strong competitiveness, superior performance, emerging markets, and technologies (Walter, 2021; Žitkienė and Deksnys, 2018; Project Management Institute, 2017a). Enhancing education and technology, and increasing customer expectations resulted in complex, uncertain, and volatile environments (Walter, 2021; Ahlbäck *et al.*, 2017; Vinodh *et al.*, 2010; Tsai *et al.*, 2008). Organizational environment is a significant factor that affects structures, strategies, and as a result, performance (Meinhardt *et al.*, 2018). Besides, business processes, organizational structure and relations in the supply chain becomes more complex (Sojan and Ajayakumar, 2019). In addition to these challenges, the coronavirus disease (COVID-19) pandemic which emerged in China at the end of 2019 spread rapidly all over the world and created significant social, environmental and economic consequences globally (Tamtam and Tourabi, 2020). Many organizations have experienced a harsh impact and tried to find ways to survive (Francis, 2020).

In these changing circumstances, companies need to sense the change and respond effectively and rapidly to survive and become successful (Lin *et al.*, 2006; Overby *et al.*, 2005; Brown and Agnew, 1982). The problem of dealing with dynamic and changing environments was considered by both academia and industry, and many solutions were proposed (Sherehiy *et al.*, 2007). Among the proposals organizational agility was one of the significant and predominant concepts, enabling an organization to survive, stay competitive and sustain success in unpredictable environments (Žitkienė and Deksnys, 2018; Felipe *et al.*, 2017; Harraf *et al.*, 2015; Ganguly *et al.*, 2009; Sherehiy *et al.*, 2007; Dove, 1992).

Like other industries, the construction industry also faces challenges with globalization, an extremely competitive environment, external market impacts, changing customer, stakeholder requirements, and other problems (Demir *et al.*, 2013; Ribeiro and Fernandes, 2010). In addition, the nature of the construction industry is complex, dynamic, and fragmented which leads to uncertainty (Demir *et al.*, 2013; Salem *et al.*, 2006; Bertelsen, 2003; Dainty *et al.*, 2002). Besides that, the construction industry suffers from persistent

problems such as low productivity, low quality, delays, and cost overruns (Çardak, 2019; Proverbs *et al.*, 2000). Hence, agility, which has its origins in the manufacturing industry and project management in information systems, was also proposed as a solution to deal with the uncertain and changing environment of the construction industry (Owen and Koskela, 2006). Even though agility is at an early stage in the construction industry (Demir *et al.*, 2013), it has the potential to provide performance improvements (Çardak, 2019; Sohi *et al.*, 2016; Owen and Koskela, 2006).

1.1. Research Gap

Agility was founded and developed in the manufacturing and information systems industries (Owen and Koskela, 2006). Therefore, most of the studies in organizational agility are present in the research areas of the software development industry and manufacturing industry. Previous studies investigating agility in the construction industry are very limited in comparison with other industries. Besides that, the existing literature in the construction industry mainly concentrates on supply chain agility and agile project management, while organizational agility research is very limited. The investigation of specific areas is needed, however, this separation may result in a lack of understanding of the working mechanism of these separate areas together in an organization (Walter, 2021). Therefore, agility should be seen as a concept for the overall organization (Sherehiy *et al.*, 2007). Considering the need for agility in the construction industry, the need for investigation of agility from the perspective of the overall organization, and the lack of research in this area, a clear research gap is present. Organizational agility in the construction industry needs further investigation and this study aims to fill this research gap. Further, investigation of organizational agility drivers and enablers is very limited in organizational agility literature. Existing studies examine some drivers and enablers, however, there is no comprehensive study investigating their interrelations as well. This study also provides an analysis of these effects.

1.2. Aim and Objectives of the Study

This study aims to propose a comprehensive model of organizational agility of Turkish construction firms. One of the objectives of the study is to define organizational agility in the context of the construction industry. Another objective is to determine the organizational

agility components such as capabilities, drivers, and enablers based on literature review and interviews. Accordingly, it is intended to develop a comprehensive model investigating organizational agility focusing on Turkish construction companies. Further, this study focuses on observing interrelationships between organizational agility drivers, organizational agility, and its enablers. As a result, it is intended to reveal the direct and indirect relations of the proposed concepts with the help of empirical data from Turkish construction companies.

1.3. Methodology

In the study, a comprehensive literature review was conducted. Organizational agility definitions, its similarities, and differences with other concepts, mostly mentioned components of organizational agility, existing models, and assessment methods were reviewed. Further, unstructured interviews were conducted with practitioners and academics from the construction industry to conceptualize organizational agility better in the construction industry. Based on this background, a conceptual model was proposed. The model included organizational agility, environmental changes that represent drivers and enablers that facilitate organizational agility. In the model, relationships between these components were hypothesized. In order to test the hypotheses, it is determined to use quantitative data. A questionnaire survey was prepared and tested with a pilot group. Then, it is distributed to practitioners working in Turkish construction companies. In total, 251 responses were collected. After, data were screened, and some answers were removed resulting in 238 responses. To develop and analyze the model, Structural Equation Modelling (SEM) method was utilized. Data were examined and analyzed using Statistical Package for Social Science (SPSS) and AMOS (Analysis of Moment Structures) Version 25 software programs. Direct and indirect relations between hypothesized constructs were reported. Further, mediation effects were investigated. Then, based on the data analysis, research findings were presented and interpreted, and relevant recommendations were made in accordance with the existing literature.

1.4. Scope and Limitations

The scope of this study covers developing a comprehensive model of organizational agility in the construction industry. This study involves only construction companies in Turkey that poses a limitation. Hence, the generalization of the results to other countries should be approached with caution. Because the results show the perceptions and opinions of Turkish construction industry practitioners about their company. The model is attempted to show organizational agility components applicable to the construction industry. Hence, implementation of the model to companies operating in other industries may require some modifications. The model includes mostly mentioned organizational agility drivers and enablers. However, they may change according to company type. Hence, further drivers, enablers, and relations between them could be hypothesized.

1.5. Organization of the Study

This study consists of five sections. The first section introduces the study by providing general information about the research background, motivation, aim and objectives, and methodology of the study along with scope and limitations. The second section summarizes the related literature about agility and organizational agility. Definition of organizational agility, its similarities and differences with other related concepts are discussed. This section also presents existing organizational agility models and components of organizational agility to reveal the elements creating an organizational agility model. The assessment of organizational agility in the existing studies is reviewed and summarized as well. Besides, organizational agility in the construction context is reviewed. In the third section, the research methodology of the study is presented in the light of this extensive literature review. The necessary background for the conceptual model and related hypothesis is given and components of the model are presented. Organizational agility drivers which are environmental changes, organizational agility capabilities that help to measure agility, and organizational agility enablers which help to facilitate agility are provided. Further, the data collection and data analysis steps are detailed. The primary data source is specified as a questionnaire survey. The data analysis method is selected as Structural Equation Model (SEM). Section four provides data analysis based on the collected data, analysis results, research findings and discussion of the findings. Data is screened and examined to detect

any problems. Descriptive statistics are also presented. Accordingly, general information regarding respondents and their companies is given. Then, data analysis is carried out by using SPSS and AMOS software programs. Model specification, identification, estimation, evaluation, and modification steps are carried out. The measurement models are assessed, then, initial and final models are presented. According to analysis results, direct, indirect and mediation effects are considered. The results of the findings are discussed, and implications are mentioned. The supported and rejected hypotheses are addressed and discussed based on the existing literature. Finally, section five draws conclusions based on major findings, discusses contributions of the study, provides several strategies for practitioners, examines limitations of the study, and presents further research ideas.

2. RESEARCH BACKGROUND ON AGILITY

This section presents a review of literature related to agility and organizational agility. The definitions from different studies were given and discussed. The attributes and components of organizational agility were investigated. The similarities and differences between agility and other concepts were indicated to better conceptualize organizational agility. The existing models for organizational agility and evaluation methods were reviewed, as well. Hence, the literature review provided a sound background for the development of the conceptual model and guided the methodology.

2.1. Agility

Agility is not a new concept. The usage of the term dates back to the late twentieth century (Singh *et al.*, 2013). Agility concept has been studied in different fields such as economics, operations research management, manufacturing, strategic management, software engineering, and information technology/information systems (Seethamraju, 2006). In the software development context, agility drew attention with the introduction of Agile Manifesto proposed by 17 software developers. Agile Software Development Alliance specified important values and principles in the Agile Manifesto (Çardak, 2019). They revealed better ways of software development by valuing more "(1) individuals and interactions over processes and tools, (2) working software over comprehensive documentation, (3) customer collaboration over contract negotiation, (4) responding to change over following a plan development" (Beck *et al.*, 2001).

In the context of manufacturing, organizational agility was popularized by a group of researchers from Iacocca Institute at Lehigh University in 1991 (Horney, 2013; Ganguly *et al.*, 2009; Yusuf *et al.*, 1999; Gunasekaran, 1998). The report provided the viewpoint of representatives from industry, government, and academia and presented a new manufacturing system (Nagel, 1991). This study became a center of interest for manufacturing studies (Sharifi and Zhang, 1999). The group proposed that organizations need to adapt to the dynamic environment and changing requirements like speed, flexibility, and response-ability (Seethamraju, 2006). The report included agile manufacturing

organizations, their elements, and operational mechanisms (Yusuf *et al.*, 1999). Iacocca Institute further specified some recommendations for the industry to become agile (Nagel, 1991).

The main motivation behind agility is the change that becomes more powerful increasingly (Grantham *et al.*, 2007). Along with globalization, advancements in technology, accumulation of knowledge, and customer requirements; competitiveness, uncertainty, and complexity increase (Najrani, 2016). In these circumstances, change becomes inevitable. Hence, agility is one of the essential requirements that an organization needs to continue as an operable entity (Dove, 2001, p. 3). There are many examples of leading companies that lost their competitive advantage and failed because of their inability to adapt to changing environments or customer requirements (Najrani, 2016). Hence, agility is essential for survival. Agility necessitates sensing changes, then responding to changes and exploiting them as opportunities (Sharifi and Zhang, 1999). Agility is not a one-time application, but it is a never-ending, continuous process (Grantham *et al.*, 2007). Principles of agility are the ability to change, organizational knowledge, customer satisfaction, intra- and inter-organization cooperation (Yusuf and Adeleye, 2002).

The definitions and perspectives of agility change in different studies. Agility is considered as a system (Yusuf *et al.*, 1999), dynamic capability (Ezcan *et al.*, 2020), key business driver (Ganguly *et al.*, 2009), business capability (Lee *et al.*, 2015), competitive strategy (Yusuf and Adeleye, 2002), competitive advantage (Nejatian and Zarei, 2013), differentiation strategy (Meinhardt *et al.*, 2018), driver of success (Project Management Institute, 2017a), and a performance outcome (Yauch, 2011).

The agility concept has been mainly predominant in the manufacturing industry (Nejatian and Zarei, 2013). Besides, agility has been a field of interest for software and information technology (IT) industries (Wendler, 2013). However, the development of agility in the manufacturing and IT sectors proceeded independently (Demir *et al.*, 2013). In earlier studies, agility was studied at the organizational level as a whole (Sharifi and Zhang, 1999; Yusuf *et al.*, 1999; Gunasekaran, 1998). Additionally, one of the main streams of agility research was agile project management. Moreover, agility has been investigated in more specific areas such as workforce agility, human resource agility, information

systems/technology agility (Walter, 2021; Žitkienė and Deksnys, 2018), business process agility (Seethamraju, 2006), and operational agility. However, agility should be seen as a concept for the overall organization (Sherehiy *et al.*, 2007). The investigation of specific areas is needed, however, this separation may result in a lack of understanding of the working mechanism of these separate areas together in an organization (Walter, 2021). Hence, transferring agility from these separate levels to the organizational level is essential to make the whole organization benefit from agility (Wendler, 2013). On the other hand, some studies extended the concept to supply chain agility (Nejatian and Zarei, 2013) and strategic agility (Sambamurthy *et al.*, 2003).

Some studies specified three levels of agility which are elemental, micro, and macro (Jin-Hai *et al.*, 2003; Yusuf *et al.*, 1999). The elemental level is related to individual resources (people, management, equipment) and functions, micro-level refers to the organizational level where the key resource is the competence of the organization, and macro-level focuses on inter-organizational relations where core competencies of different organizations are utilized (Jin-Hai *et al.*, 2003; Yusuf *et al.*, 1999). Similarly, van Oosterhout *et al.* (2005) considered agility in two levels which are enterprise level (similar to organizational level) and business network level (similar to inter-organizational level). However, the boundaries of these levels were not specified the same for all studies. In some studies, agility levels were named differently. For example, Gren (2017) explained agility in micro, meso, and macro levels where micro refers to the individual, meso indicates team level, and macro specifies organizational level. Similarly, Crick and Chew (2020) also conceptualized agility in micro, meso, and macro levels. However, they explained the levels differently. Micro-level was considered as human practice, meso level as business processes, practices, and technology systems, and macro-level as organizational level. They investigated the transition between these levels and concluded that all levels contribute to organizational agility. On the other hand, Eltawy and Gallear (2017) mentioned agility within three levels: manufacturing, organization, and supply chain. Similarly, Jackson and Johansson (2003) proposed that agility can be investigated within manufacturing, product, and market dimensions. As a different view, some studies stated that agility consists of the following dimensions: operational agility, partnering agility, and customer agility (Ravichandran, 2018; Felipe *et al.*, 2016; Sambamurthy *et al.*, 2003). Taking a comprehensive approach, Overby *et al.* (2006) stated that organizational agility encompasses

both strategic and operational issues. Even though the naming is various, the main consideration is very similar. Since these levels interact with and affect each other, it is hard to set solid boundaries. Even though there can be some overlaps with other levels, the scope of this study mainly covers the organizational agility level.

2.2. Organizational Agility

The origin of managing unpredictable and unstable environments was established in contingency theory (Sherehiy *et al.*, 2007). Contingency theory implies that adapting to contingencies provides effectiveness and high performance in the organizations. Hence, changing contingencies shape organizations that aim to maintain performance and effectiveness. The main contingencies addressed are environment, size of the organization, and strategy (Donaldson, 2001). According to the level of environmental change, organizational structure can be mechanistic or organic. Mechanistic structure, which is hierarchical, formal, and centralized, is proper in stable environments. On the other hand, in unstable and unpredictable environments, the organic structure fits by being informal, decentralized, less hierarchical, and allowing open communication (Sherehiy *et al.*, 2007; Donaldson, 2001; Burns and Stalker, 1961). The contingency of organizational size and strategy impact bureaucratic and divisional structure respectively (Donaldson, 2001).

Environmental uncertainty was considered as depending on the levels of complexity and rate of change. However, the perception of uncertainty is also important, since it affects the decisions and actions (Hatch, 2013, p. 68). The information theory of uncertainty implies that the availability of information affects the perception of environmental uncertainty. Other earlier studies that investigate how organizations deal with unpredictable and unstable environments were based on requisite variety and isomorphism concepts (Sherehiy *et al.*, 2007). Law of requisite variety indicates that "for one system to deal effectively with another it must be of the same or greater complexity" (Hatch, 2013, p. 69). Isomorphism states that organizations take the form of their environment (Hatch, 2013; Sherehiy *et al.*, 2007).

Building upon these and other related concepts, organizational agility has been studied in different fields such as economics, strategic management, manufacturing, and information systems (Trinh-Phuong *et al.*, 2012). In previous studies, the terms of organizational agility

(Walter, 2021; Anca-Ioana, 2019; Žitkienė and Deksnys, 2018; Ahlbäck *et al.*, 2017; Teece *et al.*, 2016; Nejatian and Zarei, 2013; Singh *et al.*, 2013), enterprise agility (Ganguly *et al.*, 2009; Sherehiy *et al.*, 2007; Overby *et al.*, 2005), agile enterprise (Dove, 2001; Ganguly *et al.*, 2009; Lin *et al.*, 2006; Tsai *et al.*, 2008; Tseng & Lin, 2011), business agility (Axelsson and Blomqvist, 2012; van Oosterhout *et al.*, 2005), corporate agility (Grantham *et al.*, 2007; Brown and Agnew, 1982) and agile company (Bottani, 2009) were used interchangeably. In this study, organizational agility is used as an umbrella term since it has been more commonly used.

Table 2.1. Definitions of organizational agility.

Reference	Organizational Agility Definition
(Brown and Agnew, 1982)	"[…] the capacity to react quickly to rapidly changing circumstances, requires a focus on clear system output goals and the capability to match human resources to the demands of changing circumstances."
(Nagel, 1991)	"[…] a manufacturing system with extraordinary capabilities (internal capabilities: hard and soft technologies, human resources, educated management, information) to meet the rapidly changing needs of the marketplace (speed, flexibility, customers, competitors, suppliers, infrastructure, responsiveness)."
(Goldman *et al.*, 1995)	"[…] the ability to thrive in a competitive environment of continuous and unanticipated change and to respond quickly to rapidly changing, fragmenting global markets that are served by networked competitors with routine access to a worldwide production system and are driven by demand for high-quality, high-performance, low-cost, customer-configured products and services."
(Kumar and Motwani, 1995, p. 36)	"[…] a firm's ability to accelerate the activities on critical path, and is, therefore, a direct indicator of a firm's time-based competitiveness."
(Cho *et al.*, 1996, p. 323)	"[…] the capability of surviving and prospering in a competitive environment of continuous and unpredictable change by reacting quickly and effectively to changing markets, driven by customer-designed products and services."
(Yusuf *et al.*, 1999, p. 37)	"[…] the successful exploration of competitive bases (speed, flexibility, innovation proactivity, quality and profitability) through the integration of reconfigurable resources and best practices in a knowledge-rich environment to provide customer-driven products and services in a fast changing market environment."
(Sharifi and Zhang, 1999, p. 496)	"[…] is the ability to cope with unexpected changes, to survive unprecedented threats of business environment, and to take advantage of changes as opportunities."
(Dove, 2001, p. 9)	"[…] the ability to manage and apply knowledge effectively, so that an organization has the potential to thrive in a continuously changing and unpredictable business environment."
(Bessant *et al.*, 2002)	"[…] the organization's capacity to gain competitive advantage by intelligently, rapidly and proactively seizing opportunities and reacting to threats."
(Jin-Hai *et al.*, 2003, p. 7)	"[…] the strategic process of responding to the competitive environment of continuous and unpredictable change by reacting quickly and effectively to changing markets. It takes multiple winners (manufacturers, suppliers and customers) as an objective, integration (of resources, methods, technologies, departments) as the means, with IT as an essential condition and core competence as the key."

Table 2.1. Definitions of organizational agility. (cont.)

(Sambamurthy *et al.*, 2003, p. 245)	"[…] the ability to detect opportunities for innovation and seize those competitive market opportunities by assembling requisite assets, knowledge, and relationships with speed and surprise. Agility encompasses the exploration and exploitation of opportunities for market arbitrage."
(van Oosterhout *et al.*, 2005)	"[…] being able to swiftly and easily change businesses and business processes outside the normal level of flexibility to effectively deal with highly unpredictable external and internal changes."
(Overby *et al.*, 2005, p. 296)	"[…] the ability of firms to sense environmental change and respond appropriately."
(Ganguly *et al.*, 2009, p. 414)	"[…] the ability of an organization to rapidly and efficiently response to any proactive/reactive changes in the technology/industry without compromising with the cost and the quality of the product/service that it is catering."
(Worley and Lawler, 2010, p. 194)	"[…] a dynamic organization design capability that can sense the need for change from both internal and external sources, carry out those changes routinely, and sustain above average performance."
(Charbonnier-voirin, 2011, p. 123)	"[…] a response capability which is intentionally sought out and developed by the organization in order to enable it to act efficiently in a changing environment characterized in particular by complexity, turbulence, and uncertainty."
(Lu and Ramamurthy, 2011, p. 933)	"[…] a firm-wide capability to deal with changes that often arise unexpectedly in business environments via rapid and innovative responses that exploit changes as opportunities to grow and prosper."
(Tallon and Pinsonneault, 2011, p. 464)	"[…] the ability to detect and respond to opportunities and threats with ease, speed, and dexterity."
(Horney, 2013, p. 2)	"[…] the dynamic capability to anticipate and respond to challenges and opportunities with focused, fast and flexible people, processes and technology."
(Singh *et al.*, 2013, p. 10)	"[…] the ability of a firm to sense and respond to the environment by intentionally changing (1) magnitude of variety and/or (2) the rate at which it generates this variety relative to its competitors."
(Teece *et al.*, 2016, p. 17)	"[…] the capacity of an organization to efficiently and effectively redeploy/redirect its resources to value creating and value protecting (and capturing) higher-yield activities as internal and external circumstances warrant"
(Ahlbäck *et al.*, 2017)	"[…] the ability to quickly reconfigure strategy, structure, processes, people and technology toward value-creating and value-protecting opportunities"
(Project Management Institute, 2017a)	"[…] is the capability to quickly sense and adapt to external and internal changes to deliver relevant results in a productive and cost-effective manner."
(Žitkienė and Deksnys, 2018, p. 118)	"[…] an organizational ability to recognize unexpected changes in the environment and appropriately respond in a swift and efficient manner, by utilizing and reconfiguring internal resources, thus gaining competitive advantage in the process."
(Walter, 2021, p. 37)	"[…] a learned, permanently-available dynamic capability that can be performed to a necessary degree in a quick and efficient fashion, and whenever needed in order to increase business performance in a volatile market environment."

The definition of organizational agility has been ambiguous and there is no generally accepted definition (Geiger *et al.*, 2020; Najrani, 2016; Sherehiy *et al.*, 2007; van Oosterhout *et al.*, 2005). In several studies, organizational agility was defined in terms of similar and different perspectives as can be seen in Table 2.1. The given definitions of organizational

agility are not attempted to be comprehensive, but representative of reviewed studies. A review of organizational agility definitions gives insight into common elements of organizational agility. Organizational agility is commonly separated into two components which are sensing and response (Overby *et al.*, 2005). Following these previous definitions, organizational agility can be simply defined as the ability of an organization to perceive internal and external changes and respond properly.

Almost all definitions consider agility as dependent on environmental change (Singh *et al.*, 2013). The environment is characterized as competitive (Sambamurthy *et al.*, 2003; Cho *et al.*, 1996), rapidly changing (Nagel, 1991; Brown and Agnew, 1982), volatile (Walter, 2021), complex, turbulent, uncertain (Charbonnier-voirin, 2011); which also encompasses continuous and unpredictable external and internal changes (Project Management Institute, 2017a; van Oosterhout *et al.*, 2005; Jin-Hai *et al.*, 2003; Goldman *et al.*, 1995), proactive/reactive changes (Ganguly *et al.*, 2009) and threats and opportunities (Tallon and Pinsonneault, 2011; Sharifi and Zhang, 1999).

In existing definitions, perceive refers to sense (Project Management Institute, 2017a; Worley and Lawler, 2010; Overby *et al.*, 2005), detect (Tallon and Pinsonneault, 2011; Sambamurthy *et al.*, 2003), explore (Sambamurthy *et al.*, 2003; Yusuf *et al.*, 1999), recognize (Žitkienė and Deksnys, 2018), anticipate (Horney, 2013), manage and apply knowledge, and knowledge management (Dove, 2001). In definitions, response is specified as respond (Žitkienė and Deksnys, 2018; Horney, 2013; Tallon and Pinsonneault, 2011; Overby *et al.*, 2005; Jin-Hai *et al.*, 2003) and react (Cho *et al.*, 1996; Brown and Agnew, 1982) to changes. Other aspects of response are to cope with (Sharifi and Zhang, 1999), deal with changes (Lu and Ramamurthy, 2011; van Oosterhout *et al.*, 2005), to reconfigure (Ahlbäck *et al.*, 2017), redeploy/redirect (Teece *et al.*, 2016) resources, to seize (Sambamurthy *et al.*, 2003), take advantage of (Sharifi and Zhang, 1999) and exploit the opportunities (Lu and Ramamurthy, 2011; Sambamurthy *et al.*, 2003), and to thrive (Dove, 2001; Goldman *et al.*, 1995). Dove (2001, p. 21) specified that "Being agile means being a master of change and allows one to seize the opportunity as well as initiate innovations."

In almost all definitions, speed is highlighted as an essential element (Sherehiy *et al.*, 2007). Some other terms used for speed are quick (Ahlbäck et al., 2017; Project Management

Institute, 2017a; Jin-Hai et al., 2003; Cho et al., 1996; Goldman et al., 1995; Brown and Agnew, 1982), rapid (Lu and Ramamurthy, 2011; Ganguly *et al.*, 2009; Brown and Agnew, 1982), swift (Žitkienė and Deksnys, 2018; van Oosterhout *et al.*, 2005) and high rate (Singh *et al.*, 2013). The response is expected to be effective (Teece *et al.*, 2016; van Oosterhout *et al.*, 2005; Jin-Hai *et al.*, 2003; Cho *et al.*, 1996), efficient (Žitkienė and Deksnys, 2018; Teece *et al.*, 2016; Ganguly *et al.*, 2009), appropriate (Žitkienė and Deksnys, 2018; Overby *et al.*, 2005) and innovative (van Oosterhout *et al.*, 2005). Appropriateness of sensing and response was indicated by Overby *et al.* (2005). They stated that sensing and response should be in line with organizational goals. Because short-term opportunities may distract long-term goals. Moreover, Singh *et al.* (2013) proposed that sense and response can be considered in terms of magnitude and rate of variety change.

Other important elements of agility are being driven by demand for low cost (Project Management Institute, 2017a; Ganguly *et al.*, 2009), high quality (Ganguly *et al.*, 2009; Yusuf *et al.*, 1999), high customer orientation (Sherehiy *et al.*, 2007; Cho *et al.*, 1996; Goldman *et al.*, 1995) and value creation (Ahlbäck *et al.*, 2017). In some definitions benefits of organizational agility were mentioned as well, such as to sustain above average performance (Worley and Lawler, 2010), to grow and prosper (Lu and Ramamurthy, 2011), and to increase business performance (Walter, 2021). In the review of Anca-Ioana, (2019), definition perspectives of organizational agility were given as “adaptation to change, opportunities, competitive advantage, agile workforce, benefits, characteristics”. On the other hand, de Oliveira *et al.* (2012) indicated that “agility is manifested by factors like continuous improvement, continuous delivery, and communication, maturity of the team and people flexibility”. These patterns also can be seen in presented definitions.

Singh *et al.* (2013) proposed that organizational agility includes the change in terms of magnitude and rate of variety which have negative relation. In the study, it was proposed that agility is a movement rather than a location in the magnitude-rate space. Organizations with a higher magnitude of variety change become more innovator, with a higher rate of variety change becomes more adaptive, when the other dimension is constant. The higher change in both magnitude and rate results in disrupter organizations that are rare (Singh *et al.*, 2013).

Najrani (2016) investigated organizational agility in terms of implemented strategies which are reactive, proactive, and innovative agility. Reactive agility refers to responding to changes after they are recognized; proactive agility refers to detecting new tendencies in the market early and optimizing the organizational strategy, accordingly; innovation agility refers to creating new products that have not been discovered. Organizations should be able to implement these to be successful globally (Najrani, 2016).

Even though the definition of agility is attempted to be generalized, "Agility vary by industry" (Overby *et al.*, 2005). Even for the organizations operating in the same industry, organizations create their methods based on the project characteristics and organizational requirements (Project Management Institute, 2017a). Hence, it is not very likely to have one strict generalized definition of organizational agility.

Previous research shows that organizational agility affects organizational performance positively (Ravichandran, 2018; de Oliveira *et al.*, 2012). Agile organizations were found to generate revenue 37% faster and 30% higher profits when compared to non-agile organizations (Glenn, 2009). Similarly, another report showed that 79% of organizations with high agility gain at least 5% revenue growth, whereas only 29% of organizations with low agility (Project Management Institute, 2017a). Organizational agility can help to decrease costs, satisfy customer needs, grow market share and increase competitiveness of the organization (Lin *et al.*, 2006). Similarly, Vázquez-Bustelo *et al.* (2007) deduced that firms implementing manufacturing agility are stronger in terms of cost, quality, flexibility, delivery, service, and environmental perspectives and as a result, more competitive. Besides, agility is found to enhance operational and financial performance but mostly market performance. Report of Project Management Institute (2017a) specified highly agile organizations can manage costs, increase value, reduce risks, create a cross-functional and collaborative atmosphere. The report further specified that organizations with high agility are more successful in meeting project objectives than organizations with low agility (Project Management Institute, 2017a). In the construction industry, some benefits are also expected such as reduced cost and delivery time and increased customer satisfaction (Sojan and Ajayakumar, 2019).

2.3. Organizational Agility and Related Concepts

Several concepts are highly related to organizational agility (Overby *et al.*, 2005). Some terms have various meanings from different perspectives, while some terms have similar meanings based on the context (Horney, 2013). Understanding the similarities and differences of these concepts with organizational agility can clarify the meaning and implementation (Walter, 2021).

2.3.1. Organizational Agility as a Capacity or Capability

Previous studies conflicted about the definition of agility as a capacity, a capability, or both (Singh *et al.*, 2013). Capacity and capability terms were sometimes used interchangeably which is misguiding (Geiger *et al.*, 2020). Most of the studies defined organizational agility as a capability (Project Management Institute, 2017a; Lu and Ramamurthy, 2011; Cho *et al.*, 1996). Ability, capability, dynamic capability, and some other terms were used to describe "the enabling mechanisms of agility as well as the bounded potential of agility" (Singh *et al.*, 2013, p. 17). In many studies, organizational agility was considered within the dynamic capabilities framework (Walter, 2021; Felipe *et al.*, 2016; Teece *et al.*, 2016; Sud-on *et al.*, 2014; Horney, 2013; Worley and Lawler, 2010; Sambamurthy *et al.*, 2003). Dynamic capabilities of an organization reflect the way of "integrating, building, and reconfiguring internal and external competences to address changing business environments" (Teece *et al.*, 2016, p. 18). Overby *et al.* (2005) stated that despite the similarities between organizational agility and dynamic capability concepts, the latter is more extensive. Dynamic capabilities are appropriate for all organizational processes, while organizational agility focuses on processes related to sensing and responding to changes (Overby *et al.*, 2006).

On the other hand, some researchers considered organizational agility as an organization's capacity (Ravichandran, 2018; Singh *et al.*, 2013). Agility capacity can be considered as the range that an organization can move according to conditions at any time. According to Singh *et al.* (2013), in the organizational agility concept, capacity specifies being agile, while capabilities indicate becoming agile and are essential for gaining capacity. Further, several studies considered the similarities between organizational agility and

absorptive capacity concept. Absorptive capacity is "a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability" (Overby *et al.*, 2006, p. 121). While absorptive capacity mainly focuses on managing knowledge, organizational agility emphasizes managing change (Walter, 2021; Overby *et al.*, 2006).

2.3.2. Organizational Agility, Flexibility and Adaptability

The definitions of organizational agility reveal that it involves elements of two prior concepts: organizational flexibility and organizational adaptability (Felipe *et al.*, 2016; Sherehiy *et al.*, 2007). In this respect, the flexibility and adaptability concepts can be reviewed to discover the background of agility. Flexibility, adaptability and agility were used interchangeably in several studies (Trinh-Phuong *et al.*, 2012). Even though these concepts have similar elements, they are distinct in several ways.

Flexibility is the "ability of a system to change status within an existing configuration (of pre-established parameters)" (Bernardes and Hanna, 2009, p. 41). Flexibility was inspected in different categories such as design, product, machine, volume, resources, people, manufacturing system, organizational and strategic flexibility (Walter, 2021; Vinodh *et al.*, 2010; Zhang and Sharifi, 2007). Flexibility focuses on absorbing uncertainty, on the other hand, agility also attempts to make use of uncertainty and take advantage (Walter, 2021; Bernardes and Hanna, 2009). Another significant difference is that flexibility is achieved with pre-established parameters, while in agility "the end state or situation needing change are not established a priori" (Bernardes and Hanna, 2009, p. 42). Another distinguishing point is that agility embeds speed response as an important capability on the contrary to flexibility (Ganguly *et al.*, 2009).

Adaptability is the ability to adjust organizational operations to environmental conditions (Trinh-Phuong *et al.*, 2012). Felipe *et al.* (2016) recognized organizational adaptability as reactive, and organizational flexibility as proactive perspectives. On the other hand, Katayama and Bennett (1999) considered adaptability in the context of an organization's cost performance. This study claims that adaptability provides the

modification of the cost structure to transform fixed costs into variable costs, on the other hand, agility focuses on reducing fixed costs (Walter, 2021).

Even though there are different opinions for these concepts, flexibility, adaptability, and organizational agility originated as a solution to deal with uncertain and unpredictable environments. As the most developed concept, organizational agility involves flexibility and adaptability (Bernardes and Hanna, 2009; Sherehiy *et al.*, 2007).

2.3.3. Organizational Agility and Resilience

Organizational resilience can be defined as "a firm's ability to effectively absorb, develop situation-specific responses to, and ultimately engage in transformative activities to capitalize on disruptive surprises that potentially threaten organization survival" (Lengnick-Hall *et al.*, 2011, p. 244). Even though organizational agility and organizational resilience definitions have many similarities in terms of responding to internal or external stimuli, their main difference is the stimuli type. In organizational resilience, the organization is faced with an issue or disruption that should be responded to sustain the output capability and survive. In organizational agility, the organization is faced with changes that also can be exploited as opportunities (Geiger *et al.*, 2020).

2.3.4. Organizational Agility and Lean

The relationship between lean and agility has been discussed in various studies which resulted in different perspectives. Some studies argue that leanness precedes agility, and agility is founded on lean manufacturing (Dove, 2001; Sharp *et al.*, 1999; Goldman and Nagel, 1993). On the contrary, some studies claim that agility supersedes leanness. In some studies, they were considered as mutually supporting approaches (Narasimhan *et al.*, 2006; Katayama and Bennett, 1999; Yusuf *et al.*, 1999). Apart from these, some researchers propose combining lean and agile paradigms and benefitting from this synergy (Nowotarski and Pasławski, 2016; Sohi *et al.*, 2016; Soltan and Mostafa, 2015; Demir *et al.*, 2013; Naim *et al.*, 1999).

Lean can be considered as doing more and maximizing value using fewer resources and minimizing waste. Agility can be considered as the ability to perceive internal and external changes and respond properly. Both lean and agility have similar approaches in some concepts, however, their competitive objectives are different (Walter, 2021). Both approaches consider time compression as a significant element, however, their main motivation is slightly different. In lean, eliminating non-value adding activities is a primary concern, and these activities are compressed. On the other hand, agility focuses on increasing responsiveness while compressing material and information flows (Naim *et al.*, 1999). In lean, the primary goal is to minimize waste. Agility also adopts this concept, however, to the extent that its ability to respond to changes is not prevented (Ganguly *et al.*, 2009). Both lean and agility concern value (Owen and Koskela, 2006) and customer satisfaction (Naim *et al.*, 1999). Besides; cost, lead time, quality (Naim *et al.*, 1999) and reliability are important for both methodologies (Owen and Koskela, 2006). Both lean and agile paradigms adopt some common practices such as just in time (JIT) and total quality management (TQM) (Eltawy and Gallear, 2017; Narasimhan *et al.*, 2006).

The essential difference between lean and agile is market conditions. Lean is more applicable in more stable and predictable environments whereas, in volatile and changing environments, agility is necessary (Demir *et al.*, 2013; Ganguly *et al.*, 2009). Agility provides robustness and flexibility in contrast with stability in leanness (Naim *et al.*, 1999). While agility focuses on competitiveness and taking advantage of future market opportunities, lean does not focus on these (Walter, 2021). Another difference lies behind the characteristics of workers and machines. In lean, workers are multi-skilled and machines are relatively simple whereas in agile, knowledge workers use intelligent machines (Yusuf and Adeleye, 2002). Besides, the way of planning and controlling work is different. Lean utilizes a pull system, however, in the agile approach, planning is carried out to respond quickly focusing on customer demand (Eltawy and Gallear, 2017).

2.4. Components of Organizational Agility

Agile organizations deal with change and uncertainty, hence organizations need distinctive capabilities and supporting enablers to appropriately respond to change. Therefore, the market requirements should be understood, and agility capabilities and

enablers should be employed (Tsai *et al.*, 2008). Reviewed literature shows that agility drivers, enablers, and capabilities are the main components in existing models.

2.4.1. Agility Drivers

Agility drivers are specific conditions of the internal and external environment that necessitate agility to deal with the negative impact (Walter, 2021; Wahyono, 2018). Determination of agility drivers is an essential keystone to evaluate agility (Ganguly *et al.*, 2009). The essential driver of agility is change in the environment that brings the organization to a new position and forces investigating competitive advantages (Walter, 2021; Lin *et al.*, 2006; Sharifi and Zhang, 1999; Yusuf *et al.*, 1999). Although change is not a new concept, change is much faster and dynamic, today (Lin *et al.*, 2006). The type of changes that organizations experience can vary according to company type, characteristics, and circumstances. Hence, the effects of drivers may change as well (Wahyono, 2018; Eshlaghy *et al.*, 2010). Sharifi and Zhang (1999) proposed classification of drivers which is based on the effect of changes on organizations. These areas that may be affected by changes are current activities related to processes, strategic plans that determine the position in the market, and business strategies. Despite the existence of environmental change, the perception of these changes is also significant, since the actions of organizations are affected by these perceptions (Hoyt, 1996).

Some studies investigated the environment. Hoyt (1996) adopted the view based on previous studies that the environment has three dimensions: dynamism, complexity, and munificence. “Munificence refers to the abundance of resources and the relative ability of that environment to support organizational growth. […] Dynamism reflects the level of instability in the market, and complexity describes the degree to which the environmental elements are heterogeneous and concentrated” (Hoyt, 1996, pp. 17, 18). Vázquez-Bustelo *et al.* (2007) specified the characteristics of a turbulent environment, which is the main driver of agility, as high dynamism, competition, complexity, and diversity. Meinhardt *et al.* (2018) considered the environment which is composed of organizational and general environment. They specified organizational environment dimensions that are frequently used in their systematic review. Even though there was a lack of consensus in the studies, dynamism,

uncertainty, munificence, stability-instability, and hostility were found to be mostly used along with other constructs (Meinhardt *et al.*, 2018).

Several studies identified common main types of change. In most of the studies agility drivers were categorized as follows:

- Changes in the market (Walter, 2021; Wahyono, 2018; Žitkienė and Deksnys, 2018; Tseng and Lin, 2011; Bottani, 2010; Eshlaghy *et al.*, 2010; Tsai *et al.*, 2008; Vázquez-Bustelo *et al.*, 2007; Zhang and Sharifi, 2000, 2007; Lin *et al.*, 2006; van Oosterhout *et al.*, 2005; Sharifi *et al.*, 2001; Sharp *et al.*, 1999; Sharifi and Zhang, 1999),
- Changes in competition criteria (Walter, 2021; Wahyono, 2018; Žitkienė and Deksnys, 2018; Tseng and Lin, 2011; Bottani, 2010; Eshlaghy *et al.*, 2010; Ganguly *et al.*, 2009; Tsai *et al.*, 2008; Vázquez-Bustelo *et al.*, 2007; Zhang and Sharifi, 2000, 2007; Lin *et al.*, 2006; van Oosterhout *et al.*, 2005; Yusuf and Adeleye, 2002; Sharifi *et al.*, 2001; Sharifi and Zhang, 1999),
- Changes in customer requirements (Walter, 2021; Žitkienė and Deksnys, 2018; Tseng and Lin, 2011; Bottani, 2010; Eshlaghy *et al.*, 2010; Ganguly *et al.*, 2009; Glenn, 2009; Zhang and Sharifi, 2000, 2007; Lin *et al.*, 2006; van Oosterhout *et al.*, 2005; Yusuf and Adeleye, 2002; Sharifi *et al.*, 2001; Sharp *et al.*, 1999; Yusuf *et al.*, 1999; Sharifi and Zhang, 1999),
- Changes in technology (Walter, 2021; Wahyono, 2018; Žitkienė and Deksnys, 2018; Tseng and Lin, 2011; Bottani, 2010; Eshlaghy *et al.*, 2010; Ganguly *et al.*, 2009; Tsai *et al.*, 2008; Zhang and Sharifi, 2000, 2007; Lin *et al.*, 2006; van Oosterhout *et al.*, 2005; Yusuf and Adeleye, 2002; Sharifi *et al.*, 2001; Sharifi and Zhang, 1999), and
- Changes in social/legal factors (Walter, 2021; Wahyono, 2018; Žitkienė and Deksnys, 2018; Tseng and Lin, 2011; Bottani, 2010; Eshlaghy *et al.*, 2010; Ganguly *et al.*, 2009; Zhang and Sharifi, 2000, 2007; Lin *et al.*, 2006; van Oosterhout *et al.*, 2005; Sharifi *et al.*, 2001; Sharifi and Zhang, 1999).

In addition, changes in the business network were also mentioned in some studies (Wahyono, 2018; Eshlaghy *et al.*, 2010; van Oosterhout *et al.*, 2005). Even though most of the studies focused on external changes, several studies considered internal drivers as well (Walter, 2021; Wahyono, 2018; Vázquez-Bustelo *et al.*, 2007; Zhang and Sharifi, 2000,

2007; van Oosterhout *et al.*, 2005; Sharifi *et al.*, 2001). On the contrary, Arteta and Giachetti (2004) claimed that most of the proposed metrics are backward-looking, hence they cannot identify a future, unexpected change. In that sense, they suggested that defining change a priori is problematic.

Despite the efforts of generalization and classification, agility drivers are specific to organizations and conditions. Considering agility in the construction industry context, according to the case study of Ribeiro and Fernandes (2010), most of the respondents stated that the environment is unpredictable because of some factors like a volatile and competitive market, customer demand changes, and technological changes. Similarly, Demir *et al.* (2013) concluded that construction companies are under pressure due to some environmental factors which are "globalization and competition, external market influences, improving technology, stakeholder impacts" according to interviews they conducted.

2.4.2. Agility Capabilities

Agility capabilities are abilities to appropriately respond to and take advantage of changes (Zhang and Sharifi, 2000). They represent abilities that help the organization to become more agile (Žitkienė and Deksnys, 2018). The agility capabilities are not realized continuously, however, they are used when required (Walter, 2021). Hence, the companies should develop the ability and knowledge to be used in times of need. According to Dove, (2001) two main components of agility are knowledge management and response-ability. Similarly, Overby *et al.* (2005) emphasized sensing and response capabilities. They stated that the capabilities should be selected relevant to drivers. Likewise, Žitkienė and Deksnys (2018) considered capabilities as sensing (including awareness and competence) and response (reconfiguration, learning, coordination, cooperation) capabilities. In a major portion of studies, generic agility capabilities were commonly referred to as "responsiveness, competency, flexibility, and speed/quickness" (Tseng and Lin, 2011; Eshlaghy *et al.*, 2010; Tsai *et al.*, 2008; Lin *et al.*, 2006; Sharifi *et al.*, 2001; Sharifi and Zhang, 1999). Sharifi and Zhang (1999) defined these categories and identified their sub-items. Responsiveness is the most cited capability (Zhang and Sharifi, 2007). It is defined as sensing changes, responding to them reactively or proactively, and recovering from their effects. Competency specifies the abilities that help to achieve productivity, efficiency, and effectiveness. Flexibility, as

being another mostly cited capability, provides achievement of different objectives with the same resources. Speed or quickness which is performing operations in the shortest time is another significant capability as well (Zhang and Sharifi, 2007; Sharifi and Zhang, 1999). Zhang and Sharifi (2007) added other capabilities to the list which are "proactiveness, customer focus, partnership". They described proactiveness as acting in a proactive manner rather than being reactive. Customer focus points out emphasizing the requirements of the customer. Partnership indicates constructing robust relationships with suppliers, and other firms. In addition to these, other key abilities such as learning and leanness (Ribeiro and Fernandes, 2010) were specified, as well.

Charbonnier-voirin (2011) specified agility capabilities as "mobilizing rapid response, reading the market, embedding organizational learning". These are compatible with previously identified capabilities similar to responsiveness, sensing and learning, respectively. Adler (2012) categorized capabilities of strategically agile organizations as strategic sensitivity, collective commitment, resource fluidity, collective direction, and innovation. Jackson and Johansson (2003) considered agility capabilities under four groups: "product related change capabilities; change competency; cooperation internally and externally; people, knowledge and creativity". Garbie *et al.* (2008) suggested that capabilities can be inspected within "technology, people, manufacturing strategy, and management" perspectives. Yusuf *et al.* (1999) modeled core concepts of manufacturing agility which are "core competence management, virtual enterprise, capability for reconfiguration, and knowledge-driven enterprise". Core competencies are related to the workforce and products. They can be categorized as individual level and firm level. Core competencies help to achieve customer satisfaction and reach a wide range of markets. Management should identify core competencies and missing elements. Missing elements can be improved with alliance and cooperation. A virtual enterprise is the alliance of different organizations at corporate and operational levels. This provides the use of diverse resources beyond the capabilities of the organization. Further, agile organizations have the capability of shifting, reconfiguring, realigning their business according to environmental changes. Another important concept is the utilization of information, knowledge, skills, and people as the critical resource of an organization to create solutions.

As can be seen from provided definitions and classifications, the literature lacks general agreement of agility capabilities. The same list of items could be referred to as capabilities in one study and sometimes considered as enablers in another study. In some studies, capabilities are considered as attributes (Walter, 2021; Nejatian and Zarei, 2013). On the contrary, some studies propose that agility enablers and attributes are the same (Horney, 2013). Hence, the distinction between capabilities and enablers is vague. However, mostly referred classification of agility capabilities is composed of responsiveness, competency, flexibility and speed.

2.4.3. Agility Enablers

Agility enablers, also referred to as providers, are means to achieve agile capabilities (Nejatian and Zarei, 2013; Sharifi and Zhang, 1999). They should identify and make available the agility capabilities and organizational attitudes (Tsai *et al.*, 2008). They generally consist of practices, methods, tools, and techniques (Zhang and Sharifi, 2000). Agility enablers should be compatible with the existing strategies, processes and systems of an organization. Further, interrelationships between agility enablers should also be taken into account (Walter, 2021; Lin *et al.*, 2006).

In the previous studies, different categories were identified for agility enablers. In the manufacturing agility context, Gunasekaran (1998) presented agility enablers namely "virtual enterprise formation tools, physically distributed teams, rapid partnership formation tools, concurrent engineering, integrated product/production/business information system, rapid prototyping tools, and electronic commerce". Gunasekaran and Yusuf (2002) investigated strategies and technologies of agile manufacturing and grouped them under "strategic planning, product design, virtual enterprise, automation and information technology". Sharp *et al.* (1999) presented key agility enablers as focusing on core competencies, virtual enterprise, rapid prototyping, concurrent engineering, information technology, change and risk management, continuous improvement, teamwork, multi-skilled and flexible people, and empowerment. Gunasekaran *et al.* (2019) identified agility enablers which are "mass customization, supply chain networking, manufacturing automation, employee empowerment and technology utilization".

Zhang and Sharifi (2000) and Sharifi and Zhang (1999) stated that agility providers should be investigated under areas of organization, people, technology and innovation. Besides, enablers are suggested to be integrated with information systems/technology. In a similar way, Charbonnier-voirin (2011) studied agile levers which are "structure and organization, processes, technology and people". Aligned with this study, Žitkienė and Deksnys (2018) identified agility enablers as "structure and organization, processes, technology, human resources, network". Vázquez-Bustelo *et al.* (2007) grouped agility enablers as "agile human resources, agile technologies, value chain integration, concurrent engineering and knowledge management" practices. Hoyt (1996) investigated five primary agility enablers i.e. "scanning, planning, flexible, manufacturing infrastructure, supply chain governance mechanisms, and multi-skilled employees". In the construction industry context, Ribeiro and Fernandes (2010) concluded that the main agility enablers are "people, organizational culture, collaborative work with business partners, structure and technology" in the construction small-medium enterprises.

Some studies presented agility enablers and practices as the same, according to Žitkienė and Deksnys (2018). On the other hand, Horney (2013) stated that agile practices and agile attributes are the same. Yusuf *et al.* (1999) suggested 32 agility practices, also called as attributes in the study, under "integration, competence, team building, technology, quality, change, partnership, market, education, welfare" categories. Several researchers also used these attributes in their studies (Nejatian *et al.*, 2018; Bottani, 2009, 2010; Lin *et al.*, 2006). Žitkienė and Deksnys (2018) grouped agile practices as organizational, employee empowerment, customer enrichment, and cooperation practices. Harraf *et al.* (2015) defined pillars of agility as "a culture of innovation, empowerment, tolerance or ambiguity, vision, change management, organizational communication, market analysis and response, operations management, structural fluidity and learning organization". Similarly, Project Management Institute (2017a) listed driving factors that lead to higher agility as well-trained, empowered and developed people, data-oriented and decentralized decision-making, cross-functional, collaborative and transparent organization, and effective processes.

In the literature, agility enablers were sometimes specified as providers and levers. Further, in some studies, attributes or practices were also used to indicate enablers. Even though they were named differently, when reviewed categorizations of agility enablers are

inspected, organizational, people, technology and partnership perspectives were mentioned in most of the studies.

Collectively, provided literature contributes to the understanding of agility drivers, capabilities, and enablers for an organization. It can be seen that different studies provided several perspectives. In the conceptual model and formulation of hypotheses section, a detailed explanation of agility components integrated into the model will be provided.

2.5. Agility Models

Organizational agility is a complex and multidimensional notion (Žitkienė and Deksnys, 2018). Numerous frameworks have been developed investigating agility and its characteristics. However, a common generic model could not be generated since they differ in terms of structure and perspective (Wendler, 2013). Hence, existing frameworks were reviewed, and their differences and common foundations were investigated. According to an extensive literature review conducted by Wendler (2013), existing frameworks can be categorized as agile manufacturing, agile software development, agile organization, and agile workforce. This review mainly focuses on models of agile manufacturing and agile organization.

The organizational agility concept originated in the manufacturing industry, then emerged in other industries. Hence, earlier frameworks about organizational agility were proposed in the agile manufacturing context. Gunasekaran (1998) proposed a framework for the development of agile manufacturing systems focusing on main strategies and agility enablers. Sharp *et al.* (1999) suggested a theoretical model assuming that the foundation of agility is lean manufacturing. This model was focused on agility enablers and objectives. Gunasekaran and Yusuf (2002) presented a framework for the development of the agile manufacturing system emphasizing major strategies, technologies and their links. Similarly, the focus was on agility enablers in this study, as well (Walter, 2021). Yusuf *et al.* (1999) explained core characteristics of agile manufacturing which were “core competence management, capability for reconfiguration, knowledge-driven enterprise and virtual enterprise”. They suggested a framework to achieve agility that integrates competitive bases, agility attributes, and obstacles.

Being one of the earlier studies, Dove (2001) explained agility as a balance of knowledge management and response-ability. Response-ability was examined as realizing change proficiency and reconfiguring relations. Both reactive and proactive response-ability were considered essential for agility. Knowledge management was studied as identification, acquisition and distribution of knowledge and improvement of learning. Similarly, Overby *et al.* (2005) focused on sensing and response capability dimensions which were shown as a matrix. Organizational agility was considered to be achieved when both sensing and response capabilities were high. Building upon this study, Overby *et al.* (2006) introduced enterprise agility score.

Being one of the leading studies, Sharifi and Zhang (1999) proposed an agility model consisting of agility drivers, capabilities and providers. In this model, relations between these elements were explained. Agility drivers specify the changes, agility capabilities are essential to respond to these changes, while agility providers help to achieve capabilities. Based on this, they developed a methodology for manufacturing companies which includes identifying changes, determining the level of need for agility, the current agility level, the gap between current and required agility levels, and the strategic actions to become agile. Zhang and Sharifi (2000) improved the model in terms of relations between agility elements and the implementation process. They conducted questionnaire survey and case studies to validate the model and methodology. Further, Sharifi *et al.* (2001) enhanced this model by emphasizing strategic abilities. The model and methodology were supported by questionnaire survey and case studies conducted in the manufacturing companies. Similar to these models, Zhang and Sharifi (2007) proposed an agility framework focusing on manufacturing strategy. They grouped strategies as "quick, responsive and proactive" by using cluster analysis based on extensive questionnaire survey data collected from manufacturing firms.

Meredith and Francis (2000) exhibited agile manufacturing as an agility wheel where all factors were interrelated. The wheel was composed of "agile strategy, processes, people and linkages" categories. Francis (2020) recently further developed the agility wheel that is composed of "agile strategy, processes, ecosystem, momentum and capabilities". Axelsson and Blomqvist (2012) investigated the factors that impact business agility. Core competencies of the organization, information technology, organizational structure,

collaboration, cultural change and supply chain were considered as main factors affecting business agility, and a model was developed accordingly.

Yusuf and Adeleye (2002) investigated relations between agile drivers, capabilities and performance. They proposed that agility capabilities neutralize the effect of agility drivers. Besides, both agility drivers and capabilities were expected to impact performance. Vázquez-Bustelo *et al.* (2007) modeled agile manufacturing considering agility drivers, enablers, and outcomes. They studied the effect of agility on project performance. Worley and Lawler (2010) proposed an agility model that robust strategy, adaptable organization design, shared leadership and identity, and value creating capabilities were expected to provide sustained performance. As it can be seen, some studies included and investigated the effect of organizational agility on performance.

Lin *et al.* (2006) developed a conceptual model based on previous studies. The model consisted of agility drivers, agility capabilities and agility enablers. Žitkienė and Deksnys (2018) proposed a generalized organizational agility conceptual model including agility drivers, capabilities, enablers and practices. They considered the sense and response mechanism in organizational agility and the relations between these elements. Being one of the most comprehensive studies, Walter (2021) conducted a systematic literature review and conceptualized a general organizational agility model. The relations between agility drivers, capabilities, and enablers along with agility dimensions were inspected. In the model, the role and functions of the management were included. Besides, the effect of agility on business performance was conceptualized. As the literature review shows, there are different veins in studies of organizational agility (Žitkienė and Deksnys, 2018).

2.6. Assessment of Agility

Agility has been attempted to be measured in different perspectives such as agility level, agility need level, agility maturity level using various methodologies. Most of the studies were conducted in the manufacturing industry context inspecting business processes, organization, or supply chain. Previous studies adopted quantitative, qualitative or mixed measurement approaches (Yauch, 2011). This section provides an overview of agility assessment in the existing literature, especially in the organizational context.

Kumar and Motwani (1995) were the first researchers developing a model to measure organizational agility (Vinodh *et al.,* 2010). They proposed an agility index which is calculated with a mathematical formula based on assigned agility weights to determine the strategic agility position of an organization. Arteta and Giachetti (2004) presented a different approach suggesting that complexity can be used as an alternative measure for agility. They proposed that less complexity leads to easier change and as a result, higher agility. They used the petri net model to measure complexity at the business process level of an organization. The simulation supported that complexity and agility are inversely proportional. However, validation is needed for this approach with sufficient empirical data.

Sharifi and Zhang (1999) contributed to measure the agility need level with the use of a scoring model. This model enables organizations to understand the business environment, thus, agility drivers and their agility need. Building upon this study, Zhang and Sharifi (2000) proposed a model to achieve agility which consists of an evaluation of agility needs and agility level. They also developed a network model to specify the relations between agility drivers, capabilities and providers based on questionnaire survey and case study data.

One of the earlier frameworks evaluating agility maturity was from Dove (2001). Maturity stages were defined as "accidental, repeatable, defined, managed and mastered" which were evaluated by assessment of change proficiency in terms of time, cost, quality and scope metrics, and reactive and proactive competency development. Wendler (2014) was one of the few researchers developing a maturity model for organizational agility in the software and IT service industry. Questionnaire survey data was utilized to specify organizational agility dimensions by exploratory factor analysis (EFA). The maturity model was composed of organizational agility dimensions which are "agility prerequisites, agility of people, structures enhancing agility". The maturity level was proposed to be calculated as an average value of the metrics given under these dimensions and to be categorized as "non-agile, agility basics, agility transition, organizational agility" which was validated by cluster analysis. Gunsberg *et al.* (2018) verified the applicability of this model with a case study in a university's division of information services. Differently, they made some modifications in the original questionnaire survey to take into account different perspectives of managers and staff. They grouped questions under "leadership and management, innovation, strategy, culture, learning and change, and structure" dimensions.

In Project Management Institute (2017a) report, some agility characteristics were used to evaluate organizational agility which are responding to opportunities quickly, considering the needs of the customer, shortening decision or review cycles, enhancing technology, using interactive project management applications, concentrating on change and risk management, preparing contingency plans, facilitating organizational integrity and having interdisciplinary teams (Project Management Institute, 2017a). Factor analysis was used to identify different themes of organizational agility. Then, linear regression was utilized to identify the contribution of these themes to organizational agility score. According to scores of organizations, they were categorized into four groups using cluster analysis. Linkevics and Sukovskis (2016) focused on the evaluation of organizational agility in software development companies. They modeled the agility of software development companies in five domains: "organization, quality, value, process and productivity". They developed the organization domain agility method and agility influence index. Being one of the generalized measurement scales of organizational agility, Charbonnier-voirin (2011) developed a scale based on qualitative (semi-structured interviews) and quantitative (questionnaire survey) data. They proposed that organizational agility can be investigated under four themes: "practices directed towards mastering change, practices valuing human resources, cooperative practices, practices of value creation for customers".

Previous studies employed various methodologies such as quality function deployment (QFD), multiple-criteria decision making (MCDM) and neural network. Baramichai *et al.* (2006) developed a model to reveal the relationship between challenges and changes in the business environment and relevant practices to improve supply chain agility. Their model, which is agile supply chain transformation matrix (ASCTM), incorporated QFD and analytical hierarchy process (AHP) methodologies. This model enabled organizations to evaluate the business environment and take necessary actions. The ASCTM model was studied and validated with a case study application by Balaji *et al.* (2014). On the other hand, Ren *et al.* (2003) revealed the impact of agile attributes on competitive bases. They collected data with a questionnaire survey and analyzed it using artificial neural network (ANN).

Agility is a multifaceted and ambiguous concept which causes the involvement of human perception in its evaluation process (Khoshsima, 2003). Hence, in most of the studies, fuzzy logic was used to eliminate linguistic judgments. There are several examples of that

fuzzy method was employed in the measurement of organizational agility, manufacturing agility, and supply chain agility. Tsourveloudis and Valavanis (2002) proposed measurement of manufacturing organizational agility with quantitative metrics which are grouped under four dimensions: “production, market, people and information”. They used IF-THEN rules based on fuzzy logic and calculated overall agility value. With a similar methodology, Khoshsima (2003) measured organizational agility based on capabilities which are given as responsiveness and flexibility; and competencies which is knowledge management. Garbie *et al.* (2008) also used fuzzy logic to assess the agility of manufacturing companies. They investigated agility under four infrastructures: “technology, people, manufacturing strategy, and management”. Ganguly *et al.* (2009) provided a conceptual model to determine metrics and assess enterprise agility. Then, they suggested quantitative metrics for agility measurement which are market share, responsiveness and cost effectiveness. Jain *et al.* (2008) suggested a new approach to evaluate supply chain agility employing fuzzy association rules mining. They used quantitative and qualitative agility attributes in the evaluation which are “cost, flexibility, profitability, quality, innovation, pro-activity, speed of response, and robustness”. Many researchers developed an agility index using fuzzy logic. Yang and Li (2002) created an agility evaluation index for mass customization product manufacturing. They utilized multi-grade fuzzy evaluation using data from a case study. Their three-grade index evaluated “mass customization enterprise organization management agility, products design agility, processing manufacture agility” levels. Shih and Lin (2002) introduced an absolute agility index for manufacturing organizations based on agility attributes using fuzzy logic. Lin et al (2006) developed a framework for measuring organizational agility based on their conceptual model. Agility capabilities which are “organization management, product design and product manufacturing” were used for assessment of organizational agility in a case study. They also developed an absolute agility index by using fuzzy logic. Vinodh *et al.* (2010) provided an agility index to measure the level of agility in an organization. Their model included 20 criteria and multi-grade fuzzy evaluation was used. Dahmardeh and Pourshahabi (2011) investigated agility evaluation in the public sector by developing a fuzzy agility index. They modeled the agile government which consists of agile attributes: “leadership, organizational change, e-government, customer service, performance management, culture and values”. Mishra *et al.* (2014) explored the effect of risk attitudes of decision-makers on organizational agility estimation. They introduced an agility index based on a multi-grade fuzzy approach. The agility index

was determined according to three levels which are agile providers, attributes and criteria. Surbakti *et al.* (2019) evaluated agility based on an agility model including agility attributes. They used fuzzy logic and developed a fuzzy agility index which is evaluated for a heavy equipment distributor company.

In some studies, fuzzy logic was combined with various methods. Bottani (2009) suggested a novel model combining QFD and fuzzy logic to enhance organizational agility. Competitive bases, agile attributes and agile enablers were determined according to the literature review. Then, QFD, in particular house of quality (HOQ), was deployed to find out the relations between them. In the first HOQ, agile attributes that improve competitive bases were determined. In the second HOQ, specified agile attributes were used to find required agile enablers. Hence, companies can decide what to implement based on this methodology according to their competitive priorities. Similar to this study, Tsai *et al.* (2008) made use of QFD to integrate agility drivers, capabilities and providers. They also developed a methodology including a fuzzy agility index to measure organizational agility. A case study was conducted to implement the proposed methodology. Results validated that the framework could improve organizational agility. Likewise, Tseng and Lin (2011) developed a framework to measure organizational agility that includes agility drivers, capabilities, and providers, suggesting the use of QFD and fuzzy logic. They validated the usefulness of their methodology through a case study in terms of converting agility drivers to strategic competitive edges.

Nejatian and Zarei (2013) proposed a model to improve organizational agility by using balance scorecard (BSC), MCDM, QFD and fuzzy logic. Key performance indicators (KPIs) were determined based on a comprehensive literature review. BSC and technique for order of preference by similarity to ideal solution (TOPSIS) were used to evaluate the importance of KPIs and the gap between current and desired levels. Critical success factors (CSFs) were determined based on the evaluation of KPIs and converted to quantitative values using fuzzy logic. After that, QFD, particularly two consecutive HOQs were developed. Similarly, Nejatian *et al.* (2018) recommended a methodology for achieving and improving agility in the organizational context. They presented an approach for organizations to identify agile attributes, agile enablers and relevant agile improvement paths. They employed BSC to evaluate organizational performance, TOPSIS to prioritize organizational critical success

factors, QFD and fuzzy logic to determine improvement paths that help to minimize the agility gap. They validated the use of methodology with a case study carried out in a food company. Beikkhakhian *et al.* (2015) examined evaluation of supply chain agility using interpretive structural model (ISM), fuzzy TOPSIS and AHP methodologies.

2.7. Models Investigating Antecedents and Outcomes of Agility

In a large number of studies, antecedents and outcomes of organizational agility were considered within models. Some studies investigated antecedents of organizational agility. Felipe *et al.* (2017) studied the effect of organizational culture on organizational agility where technology intensity is modeled as the moderator. They collected data from companies in Spain and analyzed the model using variance-based structural equation modeling which is partial least squares (PLS). Their study showed the positive effect of adhocracy, clan and hierarchy culture on organizational agility. However, the moderating effect of technology intensity was not found significant. Omrani and Zarei (2018) inspected the relation between organizational structure, information and communication technology and organizational agility. They used hierarchical regression analysis and confirmed the intermediary role of information and communication technology. Nouri and Mousavi (2020) modeled that cooperative management has a positive impact on organizational agility where empowerment of employees is acting as a mediator in between. They founded that hypotheses are supported using PLS. Cegarra-Navarro and Martelo-Landroguez (2020) explored the relationship between organizational memory and organizational agility by considering the mediating role of knowledge application and counter-knowledge. The results from data analysis of the PLS model provided that organizational memory increases knowledge application but also permits counter-knowledge. When they are present simultaneously, they may hinder organizational agility.

Further, some studies revealed the positive effect of information technology on agility. Ravichandran (2018) investigated the effect of information technology and innovation capacity on organizational agility. They developed a SEM model to reveal these relations and their effect on organizational performance as well. In the model, they specified organizational agility items under categories of customer responsiveness, operational flexibility and strategic flexibility. Zain *et al.* (2005) examined the relation between IT

acceptance and organizational agility through a SEM model. Gao *et al.* (2020) investigated the impact of IT capabilities on organizational agility by developing a PLS model. Moreover, Felipe *et al.* (2016) suggested a positive relationship between information system capabilities and organizational agility. They also assigned absorptive capacity as a mediator and further investigated the role of hierarchy culture on absorptive capacity and organizational agility relationship. Information system capabilities were found to have more of an indirect impact rather than a direct impact on organizational agility. Hierarchy culture was found to have a negative effect on absorptive capacity and organizational agility relation. Besides, they presented a partial mediator role of absorptive capacity. Mao *et al.* (2015) showed the linkage between knowledge management, IT and organizational agility. They created a PLS model and found out that knowledge management and IT have a positive effect on organizational agility. They also presented positive moderating effects of environmental uncertainty and information intensity. Besides, Panda and Rath (2018) conducted a similar study resulting in close findings.

The outcome of the organizational agility was hypothesized as performance most of the time. Vázquez-Bustelo *et al.* (2007) developed a conceptual model for agile manufacturing and inspected its effect on manufacturing strength and performance. They validated the model by collecting data through the survey method and analyzing it with SEM. Vinodh *et al.* (2012) constructed a SEM model investigating agile manufacturing and its outcomes. The reliability and validity of the model were confirmed with collected data from automotive organizations. Likewise, Sud-on *et al.* (2014) studied agility capabilities, enablers and organizational performance. They conducted a survey in the automotive part industry and analyzed the model based on exploratory factor analysis (EFA) and SEM. Govuzela and Mafini (2019) investigated small-medium enterprises in several industries. They hypothesized that “technological capability, collaborative innovation, organizational learning and internal alignment” positively affect organizational agility, and organizational agility enhances “business performance” which was validated through SEM analysis. Another researcher investigating agility and performance was Yauch (2011). In the study, agility was considered as a performance outcome. Agility was conceptualized based on environmental turbulence and organizational success. An agility index of manufacturing organizations was developed based on literature review, case study and survey data. As can

be seen from existing studies, a large portion of studies investigating antecedents and outcomes of agility tested their hypotheses with the help of the SEM methodology.

On the contrary to the focus on manufacturing organizations in most of the studies, some studies developed a holistic approach for any organization (Nejatian and Zarei, 2013; Yauch, 2011; Ganguly *et al.*, 2009). Since there is no specific model for the construction industry, influential frameworks mostly used and validated in other studies are considered as a foundation for this study.

2.8. Agility in the Construction Industry

Agility was founded and developed in the manufacturing and information systems industries (Owen and Koskela, 2006). Many industries adopted the agile approach as well, and the construction industry is one of them that draws specific attention (Sohi *et al.*, 2016; Fernandez and Fernandez, 2008). When information systems and construction industries are compared, both industries are project-based that design and product development phases are present. In both industries, value is realized through the use of product. Even though there are similarities especially in the design phase, production and construction phases are different (Owen and Koskela, 2006). Further, construction projects are more complex and include several parties. Information systems projects can be improved with incremental and iterative testing, while construction projects are applied once (Demir et al., 2013). When manufacturing and construction industries are compared, manufacturing is standardized and automated, where the environment is controlled. On the other hand, construction processes are labor-intensive and vulnerable to environmental factors (Mostafa *et al.*, 2016). The construction industry is in need of an agile approach because of both internal and external complexities and changes. Agility is at an early stage in the construction industry (Demir *et al.*, 2013). Existing literature shows that most of the studies focus on agile project management and supply chain agility.

2.8.1. Agile Project Management in the Construction Industry

Being one of the earliest studies investigating the applicability of agility to the construction industry, Owen and Koskela (2006) concluded that agile project management

can be adopted especially for pre-design and design phases, but the construction phase may be problematic. However, if the obstacles are overcome, benefits can be gained. Ribeiro and Fernandes (2010) investigated the potential of agile principles and methods on business processes of small-medium enterprises in the construction industry. They conducted case studies and grounded theory method. Environmental forces to become agile, the structure and importance of teams and people, collaboration and communication, efforts to become flexible and adaptable, use of technology and perception and implementation of agility principles were discussed in the interviews. Conclusions were drawn that agile methods have a good potential to be studied and implemented in the construction industry. However, there are some obstacles to agility adoption in the construction industry. Sojan and Ajayakumar (2019) compared traditional project management and agile project management in construction projects within "leadership style, communication management, change and scope management, risk management" perspectives. Mohammed and Jasim (2018) studied agile project management in Iraqi construction projects using a questionnaire to investigate the applicability of agile values and principles from perspectives of contractor, designer, resident engineer and beneficiary. Besides that, in several theses and dissertations, the topic of agile construction project management was studied (Çardak, 2019; Reid, 2019; Mendez, 2018; Kumara, 2017; Moriel, 2017; Oja, 2017; Johansson, 2012). In these studies, literature review (Moriel, 2017), questionnaire survey (Çardak, 2019), semi-structured interviews (Johansson, 2012) and case study (Kumara, 2017; Oja, 2017) approaches were utilized as the research methodology. Johansson (2012) specified that the implementation of agile project management in the design phase has some benefits such as increased involvement and satisfaction of clients, motivation and empowerment of people, and reduced uncertainty in the projects. Oja, (2017) also revealed some benefits of agile project management as enhanced communication, transparency, problem solving and continuous improvement. Moriel (2017) investigated the challenges and proposed possible solutions. Mendez (2018) examined several case studies of wind farm construction and developed agile implementation guidelines for renewable energy construction. In this study, observations revealed reduced rework, increased project efficiency and indirect improvement in safety when agile guidelines were implemented. Reid (2019) studied the effect of agile project management on project performance in heavy-civil construction projects. Based on quantitative data collected from agile and traditional projects, improvements in time and quality were observed. Çardak (2019) investigated the drivers, enablers, inputs, barriers,

process improvements and project level benefits based on collected data from Turkish construction companies.

2.8.2. Supply Chain Agility in the Construction Industry

On the other hand, several studies focused on supply chain agility. Thipparat (2010) evaluated agility of construction supply chain by using agility capabilities "flexibility, responsiveness and quickness, competency, and cost" as measurement criteria, in levels of "sourcing, construction and delivery". They utilized adaptive neuro fuzzy inference system for measurement. Then the model was applied to 25 companies as case studies and validated. Poloie *et al.* (2012) examined the agility of the supply chain in mass construction. They determined criteria for agility: "technology, quality, partnership, market, information technology, financial, government, society" based on literature review and expert opinion. Then, the relations between criteria were asked through a questionnaire survey. According to data obtained, they utilized the interpretive structural model (ISM). They deduced that "government" is the key criterion for agility. However, all criteria should be at an ideal level to achieve supply chain agility. Building on this study, Kiani Mavi *et al.* (2012) also investigated the same issue by utilizing the same criteria. They introduced an evaluation method using several indices. According to the questionnaire study and analysis of descriptive statistics, it was implied that "market" is the first and "information technology" is the last criterion in terms of importance. Oyegoke *et al.* (2008) studied supply chain management from the perspective of agile specialists. They provided a theoretical background and inspected a case study in Finland. Findings showed that the agile approach helped to reduce cost and time, decrease uncertainty, and mitigate communication problems.

2.8.3. Organizational Agility in the Construction Industry

In the organizational context, Clark and Baker (2004) presented the case study of "Fit Out" company from the construction industry. They invented and adopted modular construction that brings a manufacturing approach to construction. Adopting modular construction, being a virtual company, forming collaborative ventures helped the company to respond quickly to the changing needs of the airline industry and other industries as well, and as a result, to become agile. The company was also measuring improvements and

benchmarking with other companies. This shows the eagerness to improve continuously and stay competitive. They achieved high success in terms of budget, time and safety (Clark and Baker, 2004). “Fit Out” case study shows how innovation and new solutions can help to organizational agility in the construction industry context.

Being one of the very rare organizational agility studies in the Turkish construction industry, Ezcan *et al.* (2020) investigated the improvement of business agility through the diffusion of information and communication technology. They studied agile technology diffusion within “responsiveness, flexibility, competence” constructs. Collected data from case studies in Turkish construction firms implied the core capabilities of agile technology diffusion.

Few studies examined the relationship between organizational agility and other concepts. GhalichKhani and Hakkak (2016) hypothesized that business intelligence has a positive effect on organizational agility through the mediation of empowerment. They collected data from a construction engineering organization and a food retailer company. They confirmed the hypothesis and mediation effect by utilizing the PLS model. Oga and Onouha (2020) investigated entrepreneurial talent management and organizational agility relationship in construction companies operating in Nigeria. They conducted regression analysis and found that entrepreneurial talent management has a positive and significant effect on organizational agility.

As literature review provides, despite the excessive research on agility, its characteristics and frameworks; there is a prominent absence of studies in the construction industry (Ribeiro and Fernandes, 2010). The existing studies about agility in the construction context, mainly focus on agile project management or supply chain agility. In the organizational agility context, the resources are scarce. On the other hand, the literature of the manufacturing industry and other areas is limited in terms of providing a satisfactory comprehensive model explaining organizational agility. Considering this significant gap, this study aims to provide a conceptual model of organizational agility in the construction industry context.

3. RESEARCH METHODOLOGY

Research methodology depends on research objectives, study field and its implementation (Beikkhakhian *et al.*, 2015). In this study, both qualitative and quantitative approaches are taken. Mixed method research helps to investigate different purposes of the research with different data types, appropriately (Saunders *et al.*, 2009). The research methodology steps of this study are presented in Figure 3.1.

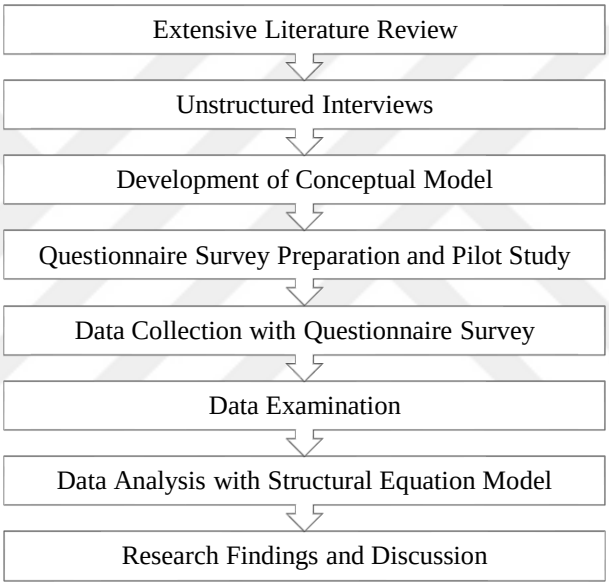

Figure 3.1. Research methodology steps.

First of all, an in-depth literature review was conducted, in this way, mostly mentioned components of organizational agility, previous models and assessment methods for agility were investigated which provided a solid background. Since the existing models mainly focus on other industries rather than the construction industry, unstructured interviews were conducted with practitioners and academics from the construction industry. Consequently, a conceptual model was proposed based on literature review, unstructured interviews, and expert opinion. The model included the main components of organizational agility which are agility drivers, agility capabilities and agility enablers. In order to test hypothesized relations in the conceptual model, a questionnaire survey was prepared. After a pilot study, it was distributed to construction industry practitioners working in Turkish construction companies.

As the primary data source, collected questionnaire survey data were examined and analyzed. SEM was utilized to construct the model and analyze the relationships between proposed constructs. Because SEM method has been used in many studies that investigate relations between antecedents and outcomes of organizational agility. Initial and final models were developed according to SEM implementation steps. After analysis of the data, research findings were presented, and relevant comments were made in accordance with the existing literature.

3.1. Unstructured Interviews

The majority of the organizational agility literature focuses on manufacturing and any comprehensive model was not proposed for the construction industry; hence, exploratory research is required. Qualitative study is a more exploratory approach that is useful to understand the topic. It is an applicable method to study organizations, groups and individuals (Johansson, 2012). In this study, unstructured interviews were conducted to take interviewees' opinions. Unstructured interviews are used to explore a novel research area. In this type of interview, the interviewee's perception guides the researcher (Saunders *et al.*, 2009). The interviewees were reached via professional online platforms like Linkedin. 5 interviews were conducted with practitioners and academicians.

One of the interviewees was the founder of a consulting company that provides consultancy in areas of agile project management and organizational agility especially for the construction industry and facility management. She was also a certified Scrum Master. Before she founded the company and started to work on agility, she had experience of 20 years in the construction industry as having different roles such as project manager, project management office manager and managing director. Another interviewee was a design manager with 14 years of experience in the construction industry. Besides, he studied agile project management in the construction industry and also published a master's thesis about this topic. One of the interviewees was a construction manager with more than 20 years of experience in the construction industry. He was also a certificated Scrum Master. He was experienced in the application of agile project management in several construction industry projects. Another interviewee was a certified agile coach with experience of 5 years in the area of agile leadership. He was also an academician who gives lectures about agility. The

other interviewee was an academician in the construction management area with 16 years of experience. He studied agility in construction firms. He also accomplished his dissertation which is related to the organizational agility of Turkish construction companies.

The interviews were conducted with interviewees one to one. They took approximately one-hour online meetings. The aim and objectives of the study were introduced briefly. Then, the opinions of interviewees were asked about organizational agility and its implications to the construction industry. The draft of the conceptual model was also shared and discussed. The meeting notes were taken by the researcher.

Even though the number of interviewees was limited, interviewees' experience level was high and the range of areas that they work on was appropriate for this study. Interviews helped to develop the conceptual model and to assess the organizational agility considering the construction industry perspective.

3.2. Development of the Conceptual Model and Formulation of Hypotheses

The development of a comprehensive model for organizational agility is challenging because of various definitions and approaches (Žitkienė and Deksnys, 2018). In this study, the similarities of previous frameworks were inspected and a general conceptual model was developed which was primarily built upon several studies (Walter, 2021; Trzcielinski, 2020; Žitkienė and Deksnys, 2018; Eshlaghy *et al.*, 2010; Ribeiro and Fernandes, 2010; Tsai *et al.*, 2008; Lin *et al.*, 2006; Sharifi and Zhang, 1999). This model is constructed to provide a working model of organizational agility. However, there are numerous interrelationships between the components, hence, the distinctions are blurred and the naming and definitions are not single and exact (Harraf *et al.*, 2015). Creating a framework restricts a continuum of various styles into some categories. Hence, the conceptual model proposed in this study is a generalization and may not apply exactly to all construction organizations, since "one size does not fit all" (Dove, 2001, p. 9).

Based on the extensive literature review and as per insights from unstructured interviews, the conceptual model was developed and improved. The conceptual model is composed of three main parts as can be seen in Figure 3.2. The first part includes the changes

in the environment affecting the construction industry which are agility drivers that necessitate agility. Drivers of agility were investigated considering PESTEL factors and the level of competitiveness in the Turkish construction industry. The change in the environment of the Turkish construction industry was presented based on data gathered from global reports and official websites. The second part presents the capabilities of an agile organization that are used to measure organizational agility. Agility capabilities were specified as sensing, responsiveness, flexibility and competency to assess organizational agility. The third part indicates the enablers of organizational agility that help organizations to become agile. In this part, mostly mentioned organizational agility enablers were specified. They were grouped as flat organizational structure, change culture, organizational learning, people, technology and external relations. In the model, their dependence and interrelationships were hypothesized.

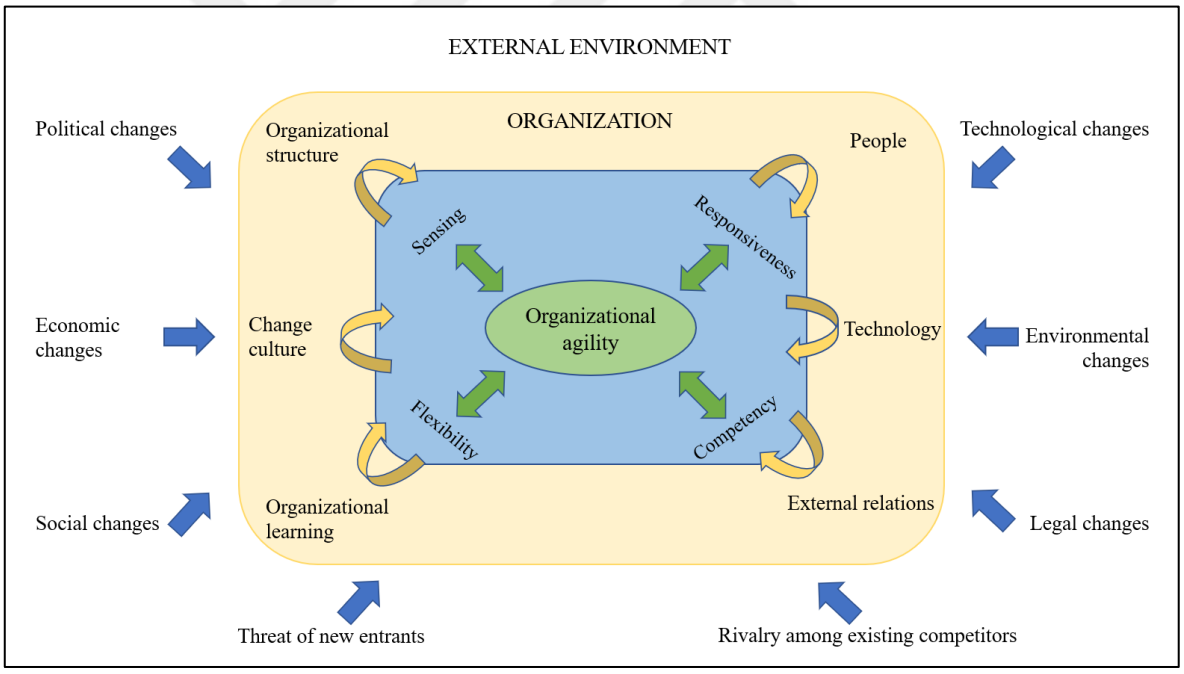

Figure 3.2. Conceptual model.

3.2.1. Environmental Changes in the Construction Industry

Determination of environmental changes is crucial to evaluate organizational agility (Ganguly *et al.*, 2009). Because the change in the environment brings the organization to a new position and forces investigating competitive advantages (Walter, 2021; Rothaermel,

2017, p. 66; Lin *et al.*, 2006; Sharifi and Zhang, 1999; Yusuf *et al.*, 1999). Hence, first of all, environmental conditions need to be investigated. In the literature, agility drivers are mostly categorized as changes in the market, competition criteria, customer requirements, technology, social and legal factors. Similar to this classification, political, economic, sociocultural, technological, environmental, legal changes, the threat of new entrants and rivalry among competitors are investigated in this study. In the following subsections, these changes are examined in Turkey and the Turkish construction industry.

The business environment is considered as a macroenvironment and the industrial environment in the theory of strategic management (Trzcielinski, 2020; Aldea *et al.*, 2013). To investigate the macroenvironment, one of the most common and powerful models is PESTEL that provides an analysis of opportunities and threats (Aldea *et al.*, 2013). In the PESTEL model, the factors are grouped as Political, Economic, Sociocultural, Technological, Environmental and Legal. It provides identification of environmental factors systematically (Construction Blueprint Consortium, 2020). The construction industry is sensitive to PESTEL factors (Cengiz *et al.*, 2019). In several studies, PESTEL was utilized to analyze the macroenvironment of the construction industry (Khalid *et al.*, 2020; Cengiz *et al.*, 2019; Pan *et al.*, 2019). In this study, the impact of macroenvironmental changes on organizational agility was considered using PESTEL, similar to the study of Trzcielinski (2020). Further, the threat of new entrants and rivalry among competitors are taken into account in order to determine the competition degree of the Turkish construction industry. Several studies used similar items to analyze the competitive environment of the construction industry (Cengiz *et al.*, 2019; Ho, 2015; Oral and Mistikoglu, 2007).

Data about the factors representing environmental changes were collected from global reports and data sources of official websites. Global Competitiveness Report (Schwab, 2019) and Global Innovation Index (Cornell University *et al.*, 2020) were inspected similar to the study of Trzcielinski (2020), and also data from the World Bank (2021) and Turkish Statistical Institute (TURKSTAT, 2021) were utilized. Considering data availability and continuity, the data were presented between 2012 and 2020 (9 years period). In the following subsections, the factors are investigated in the scope of Turkey and their effect on the construction industry is explained.

3.2.1.1. Political Factors. Political factors are related to actions of government bodies that may affect organizations (Rothaermel, 2017). After inspection of the global reports "government effectiveness" and "ease of starting a business" are considered to indicate the political factors. Government effectiveness is an index that shows perceptions about "the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies." (Cornell University *et al.*, 2020). This index is presented in Global Innovation Index (GII) and it ranges between 0 and 100. Figure 3.3 shows the change of government effectiveness of Turkey. According to this figure, government effectiveness seems to be relatively low.

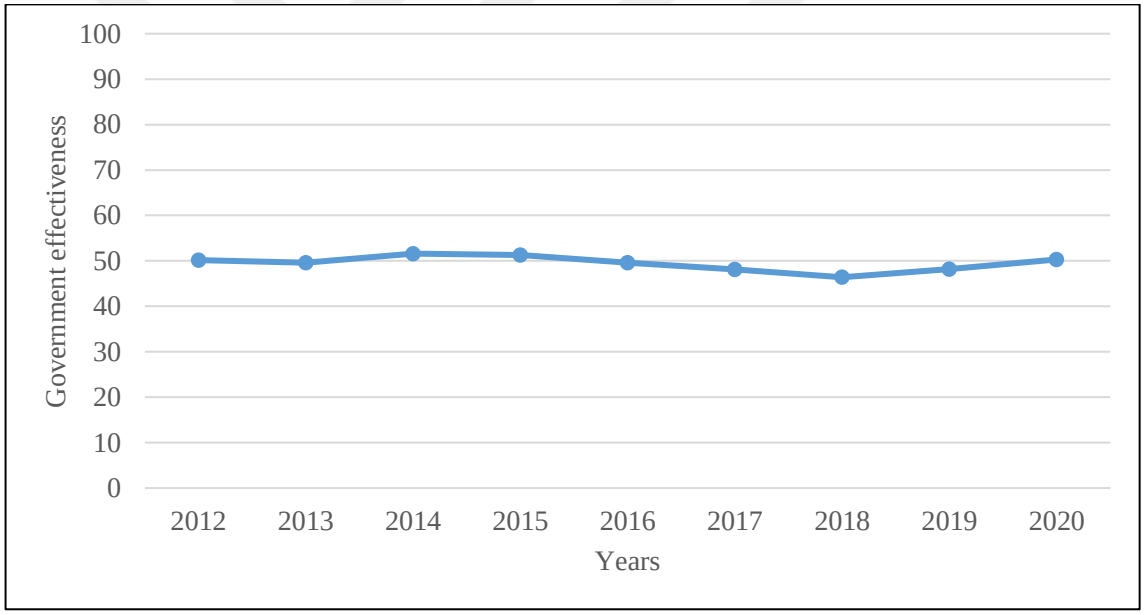

Figure 3.3. Government effectiveness index of Turkey, yearly.

Ease of starting a new business is a score that includes "obtaining all necessary licenses and permits and completing any required notifications, verifications, or inscriptions for the company and employees with relevant authorities." (Cornell University *et al.*, 2020). This score is obtained from GII and it ranges between 0 and 100. In Figure 3.4 establishing a new business seems to be relatively easy in Turkey, especially after 2013.

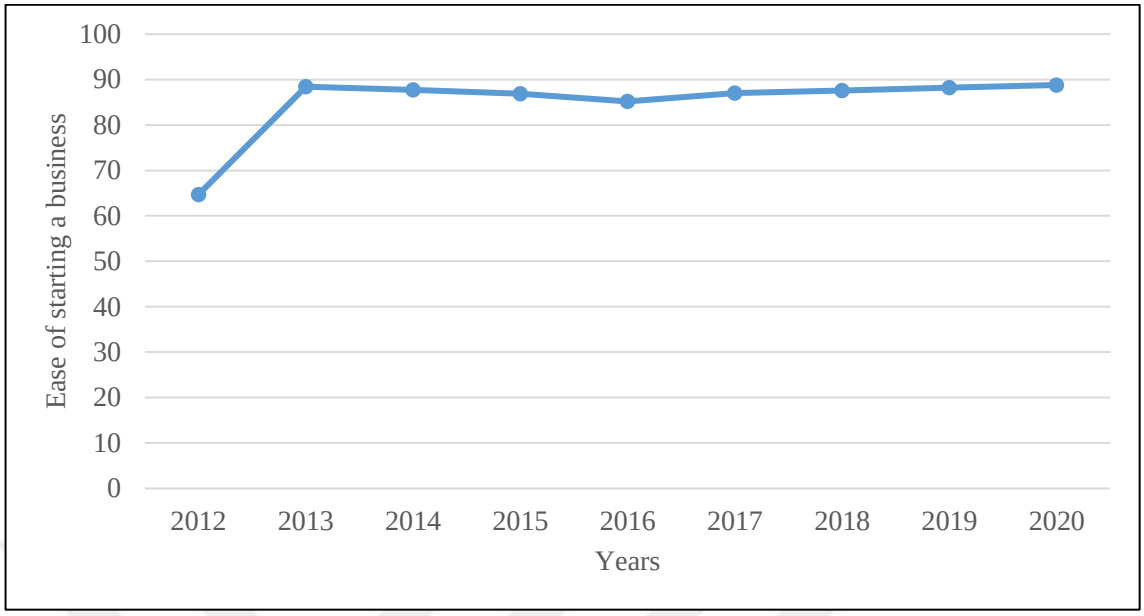

Figure 3.4. Ease of starting a new business score in Turkey, yearly.

The construction industry is sensitive to political changes (Ünal, 2020). In Turkey, the construction industry has been adversely affected by political risks, in recent years (İMSAD, 2020). In the report of Construction Blueprint Consortium (2020), the importance of a stable and visionary political structure is emphasized for the development and improvement of the construction industry. Policies should be encouraging for technology use, sustainability, energy efficiency, etc. in the construction industry.

3.2.1.2. Economic Factors. Economic factors that influence an organization are highly related to macroeconomic factors. According to suggestions of Rothaermel (2017) and Sammut-Bonnici and Galea (2015) Gross Domestic Product per capita, growth rate, employment levels, interest rate, inflation rate, and exchange rate of currency should be considered while evaluating macroeconomic changes.

Gross Domestic Product (GDP) is "the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products." (The World Bank, 2021). GDP per capita is one of the most commonly used indicators to analyze a country's economy. It is especially useful for income elastic industries such as the construction industry (Sammut-Bonnici and Galea, 2015). In Figure 3.5, GDP per capita values (in current U.S. dollars) are given for Turkey and

compared with world aggregate values according to data from the World Bank (2021). GDP per capita of Turkey has a decreasing trend and it is below world aggregate after 2017. The main reasons behind decreasing GDP per capita are economic fluctuations and depreciation of the Turkish Lira (TL).

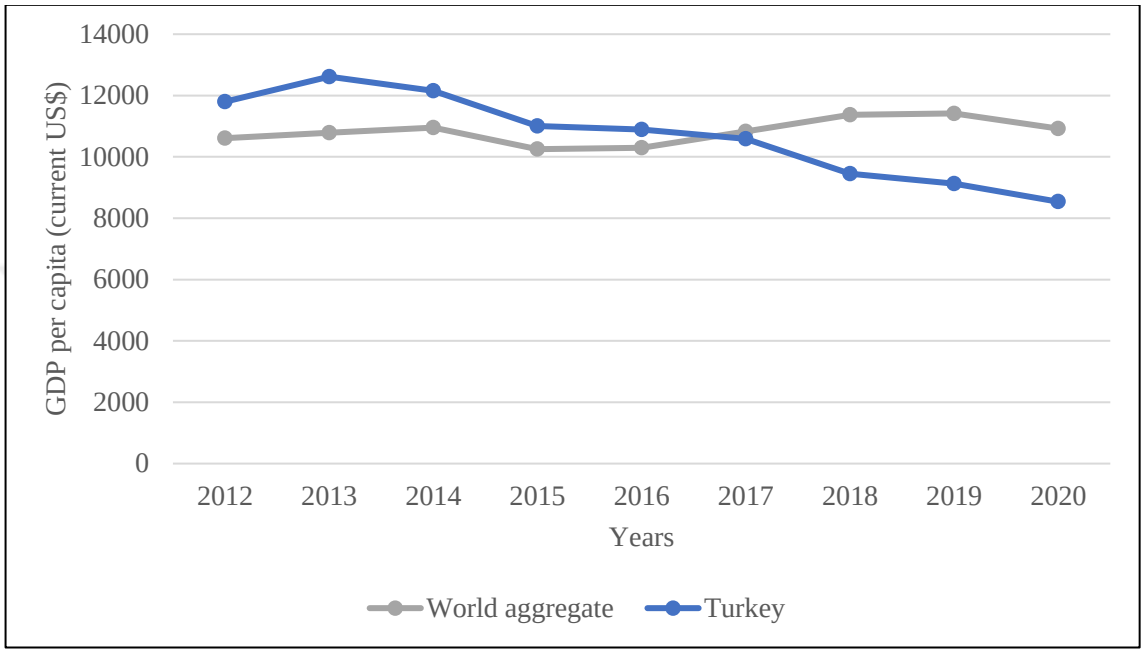

Figure 3.5. GDP per capita (in current US$) of Turkey and world aggregate, yearly.

The growth rate is given as an annual percentage change of GDP in terms of constant local currency according to the World Bank (2021) data. Turkey is known as a developing and emerging country. As can be seen in Figure 3.6, GDP growth rate of Turkey was relatively high, considering the growth rate of the world aggregate ranging between 2.3% and 3.3% according to data from TURKSTAT (2021) and the World Bank (2021). However, it falls to 0.97% in 2019 and becomes 1.76% in 2020 (O'Neill, 2021). On the other hand, although the growth rate of the construction industry followed a similar trend to the GDP growth rate until 2018, it contracted in contrast to the GDP growth rate in both 2018 and 2019. The reason for this contraction may be due to the nature and dynamics of the construction industry. Besides that, while the share of the construction industry in GDP has an increasing trend reaching 8.6% in 2017, it decreased to 7.2% and 6.5% in 2018 and 2019, respectively (TURKSTAT, 2021).

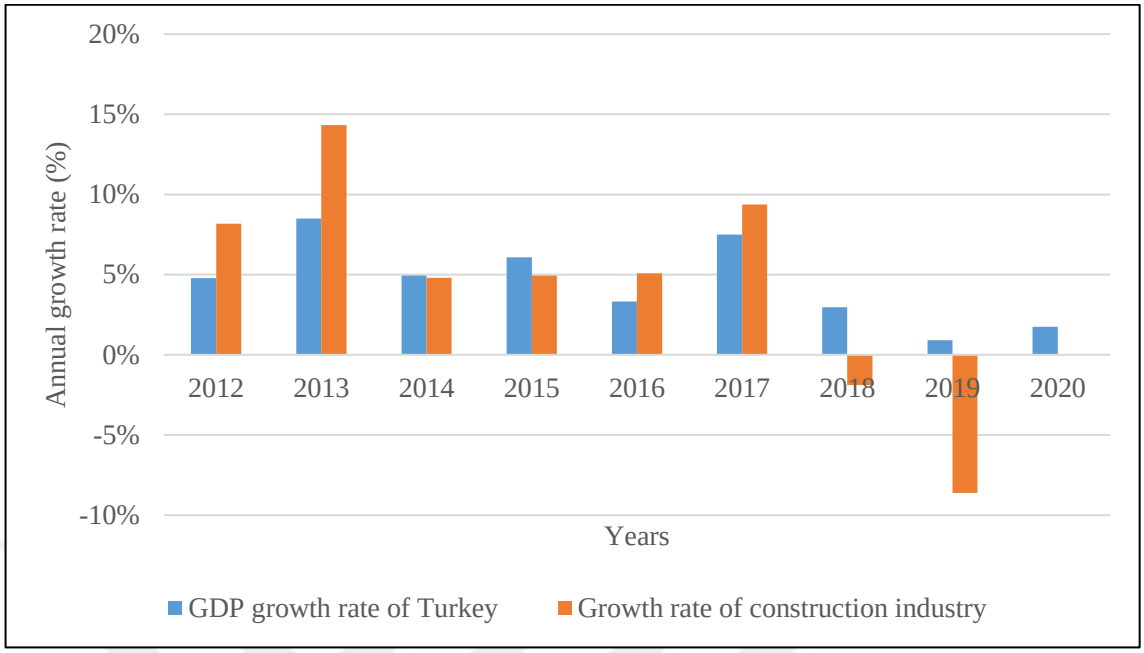

Figure 3.6. The growth rate of GDP and construction industry, yearly.

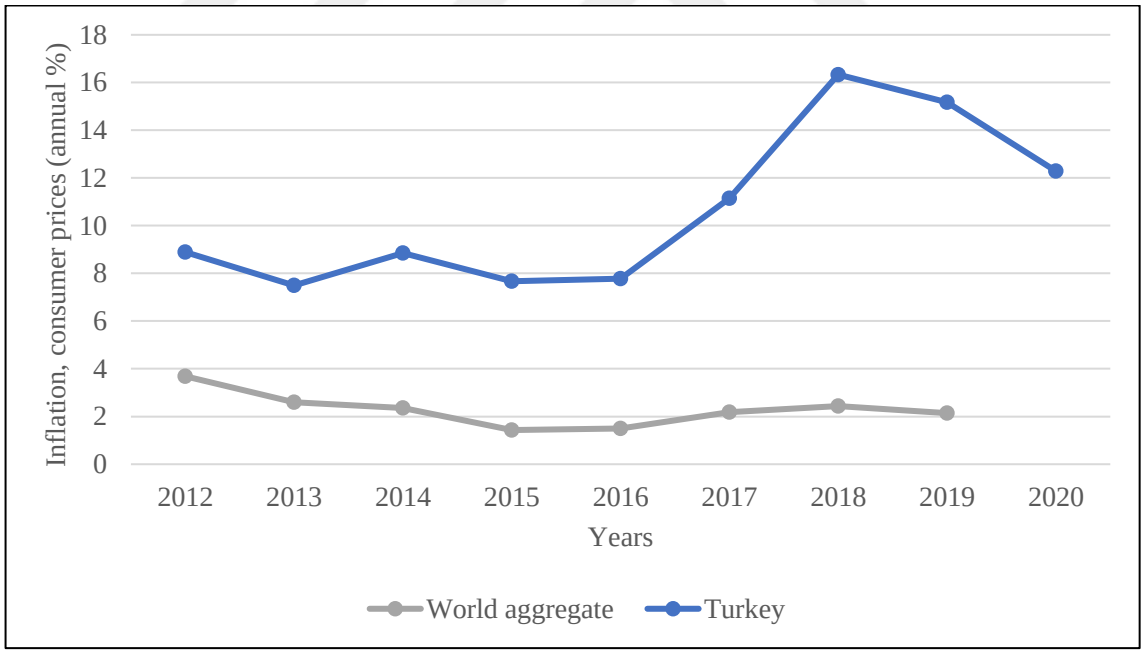

Figure 3.7. Inflation rate (consumer price index) of Turkey and world aggregate, yearly.

Price stability is another issue that companies need to address. A high volume of money in the economy causes inflation (Rothaermel, 2017). Inflation is measured by the consumer price index that "reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at

specified intervals, such as yearly." (The World Bank, 2021). Inflation causes a decrease in the purchasing power of consumers and an increase in the price of raw materials (Sammut-Bonnici and Galea, 2015). In Figure 3.7, annual inflation rate in terms of percentages is provided for Turkey and the world aggregate according to data from the World Bank (2021). Compared to the world aggregate, Turkey has a very high inflation rate. However, in recent periods, the inflation rate had a slight decrease with the help of money policies (İMSAD, 2020).

The currency exchange rate specifies the value of a local currency in terms of foreign currency. It is especially significant for companies that purchase or sell products or services beyond country borders (Rothaermel, 2017; Sammut-Bonnici and Galea, 2015). The official exchange rate for the Turkish Lira (TL) per the United States (US) dollar is given in Figure 3.8 according to data from Central Bank of the Turkish Republic (2021) and the Word Bank (2021). The exchange rate seems to be more stable until 2017. However, the values are much higher, unstable, and fluctuated after 2017.

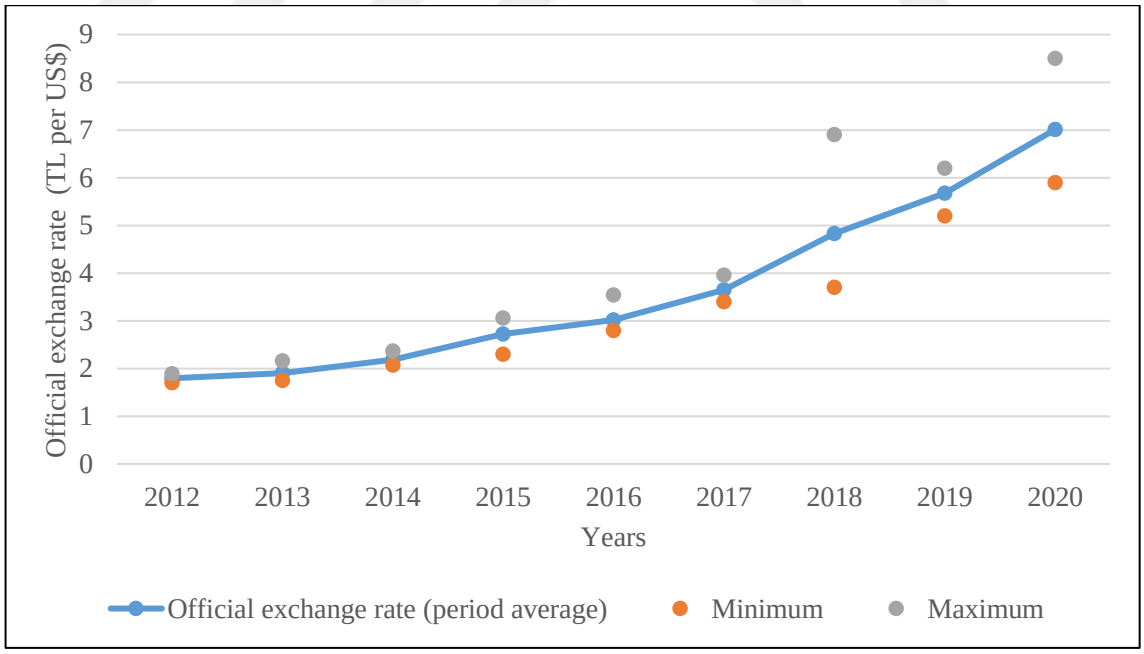

Figure 3.8. Official exchange rate (TL per US$) period average, minimum and maximum values, yearly.

The unemployment rate is the ratio of unemployed people that are available and seeking employment to the total labor force (The World Bank, 2021). It is directly influenced by the growth rate (Rothaermel, 2017). Since the growth rate was low, the capacity of creating employment was very limited as well (İMSAD, 2020). In Figure 3.9 unemployment rate for Turkey and the world aggregate is shown according to data from TURKSTAT (2021) and the World Bank (2021). In Turkey, the unemployment rate is very high compared to the world aggregate and approximately 4 million people are unemployed (TURKSTAT, 2021).

According to the seasonal and calendar-adjusted number of paid employees in the construction industry taken from TURKSTAT (2021) in Figure 3.10, there is a dramatic decrease after 2018. From January 2018 to May 2020, there was a critical drop in the number of employees which is nearly 800 thousand, and it was followed by a recovery period. The decrease may be explained as a result of the decrease in demand. On the other hand, the effect of the pandemic is undeniable.

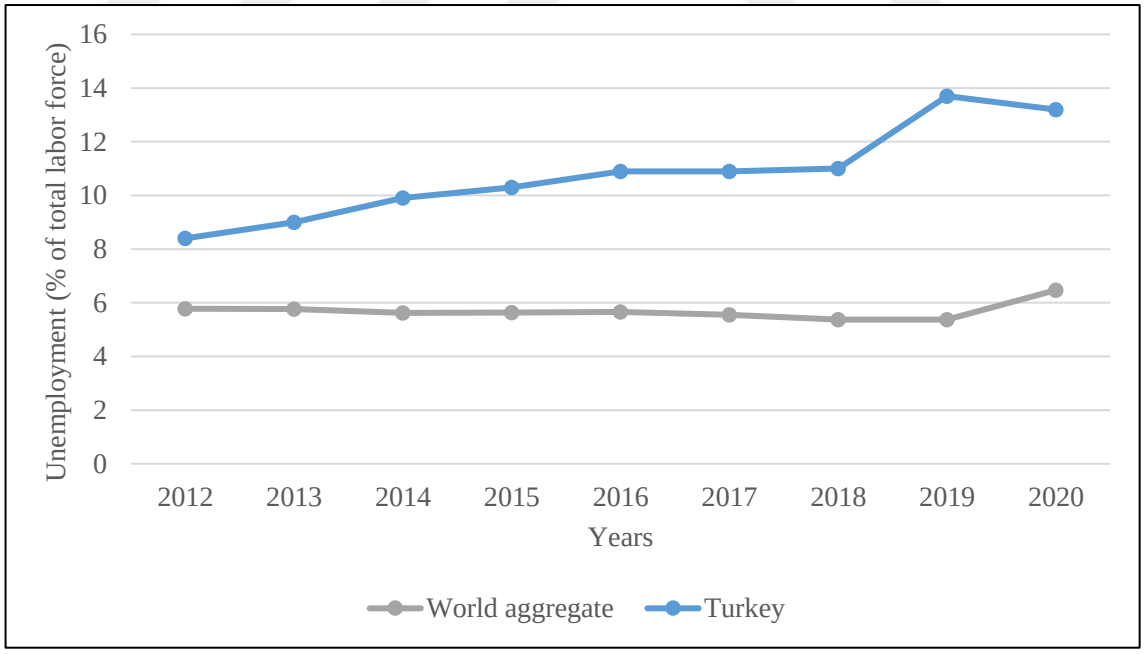

Figure 3.9. Unemployment rate (% of the total labor force) of Turkey and world aggregate, yearly.

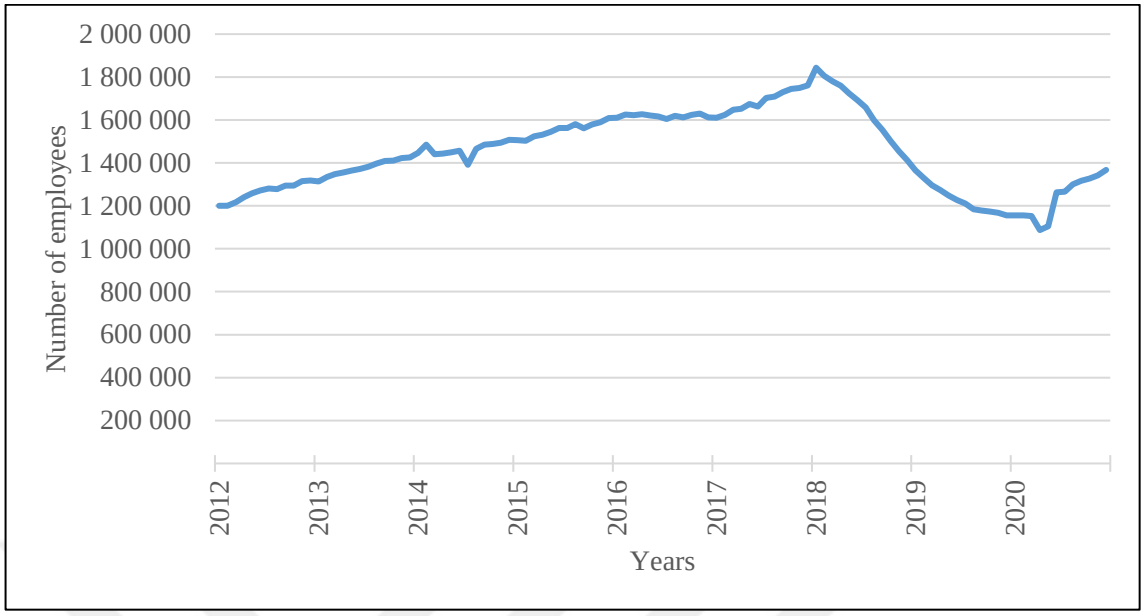

Figure 3.10. Seasonal and calendar-adjusted number of paid employees in the construction industry, monthly.

The economic confidence index is a compounded index that summarizes consumer and producer expectations and trends. Confidence index values range between 0 and 200. Index values higher than 100 indicate optimistic while values lower than 100 indicate a pessimistic approach about the present and the future (TURKSTAT, 2021). In Figure 3.11 economic confidence index and construction confidence index values between 2012 and 2020 are shown according to data extracted from TURKSTAT (2021). The economic confidence index had a relatively stable and optimistic trend between 2012 and 2018. However, after 2018 it became unstable and pessimistic. Construction confidence index values followed the same trend until 2018. Because the economic confidence index includes confidence index from different sectors including the construction industry. Recovery of the construction industry in 2019 was expected in line with the economic confidence index, however, it was quite limited (Ünal, 2020). The construction industry seems to be pessimistic, especially in 2020, the values fell below 60. However, at the end of 2020, it slightly recovered.

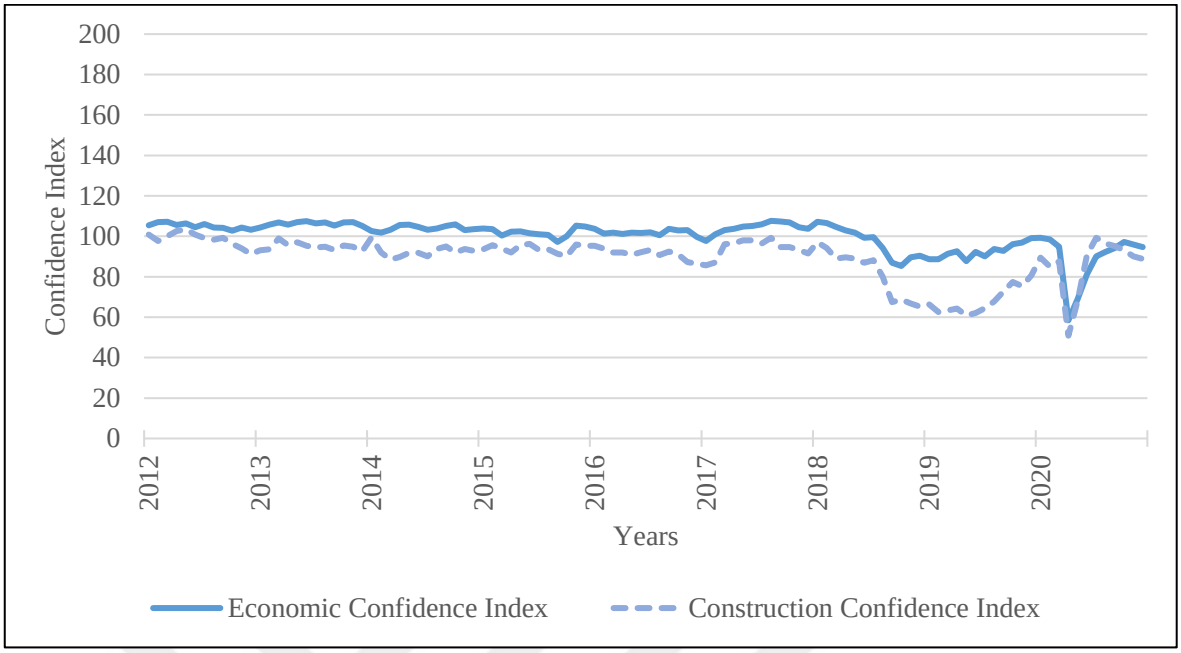

Figure 3.11. Economic confidence index and construction confidence index in Turkey, monthly.

The construction cost index is composed of workforce and resource costs. When 2015 is considered as the base year with an index value of 100, construction cost index values between 2015 and 2020 are presented in Figure 3.12 based on the data from TURKSTAT (2021). The figure shows an increasing trend. Index value goes up to 240 at the end of 2020. While construction costs were increasing gradually, total turnover values were reduced due to decreased demand. Hence, the financial performance of the construction industry has been affected negatively in recent years (Ünal, 2020).

Despite the increasing trend of construction investments in earlier years, it declined from 644.1 billion in 2018 to 580.8 billion in 2019 (İMSAD, 2020). In public sector investments, the transportation sector had the highest share which is 40.1%, while in private sector investments, the housing sector had the highest share with 31.1% (İMSAD, 2020).

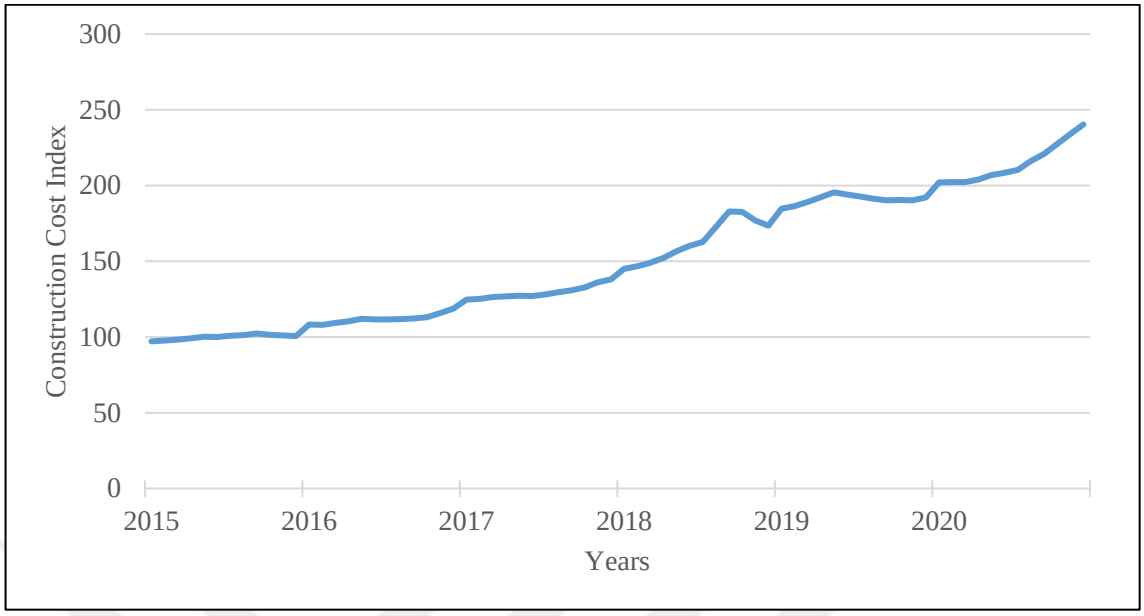

Figure 3.12. Construction cost index in Turkey, monthly (2015=100).

In Turkey, the growth rate of the economy has been traditionally built upon the construction industry. The recession in 2018 especially shows the impact of the construction industry on the economy (Ünal, 2020). On the other hand, along with affecting the economy, the construction industry is more sensitive to economic changes than other sectors (Ünal, 2020). The construction industry experienced a dramatic contraction in recent years (İMSAD, 2020). Even though the construction industry has growth potential in the long term, there are some problems especially in the short term. In order to achieve permanent recovery, economic stability and increased economic confidence need to be ensured (Ünal, 2020).

3.2.1.3. Social Factors. Social factors represent the socio-cultural, socio-demographical characteristics of a society (Construction Blueprint Consortium, 2020). The population of Turkey is 83,614,362 in 2020 (TURKSTAT, 2021). The population growth rate decreased from 1.39% in 2019 to 0.55% in 2020. The median age was 32.4 in 2019 and 32.7 in 2020 (TURKSTAT, 2021). The statistics show that the population of Turkey may become older in the long term. However, considering the growing and young population of Turkey, smaller family structure and other social and demographic features, the construction industry retains its growth potential (Ünal, 2020).

One of the significant social factors that may influence the construction industry is changes in customer behaviors. Economic factors influence the purchasing power of customers. Besides, the pandemic conditions seem to affect the choices of the customers. On the other hand, the customer profile may change as well. Since TL has depreciated against foreign currency, the demand of foreign investors is higher in recent years (Ünal, 2020).

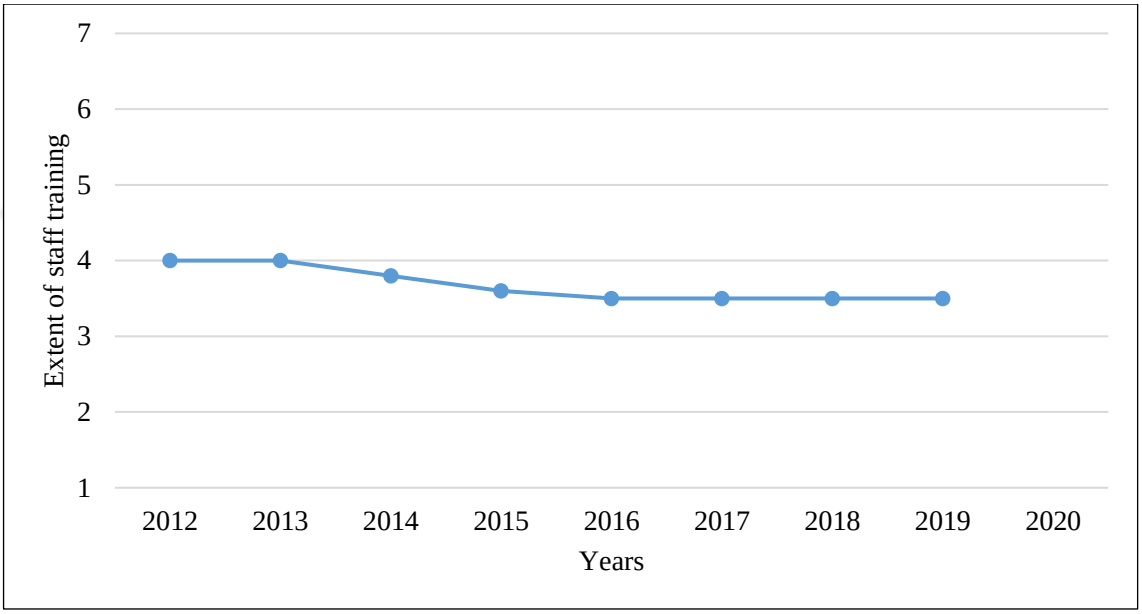

Figure 3.13. The extent of staff training in Turkey, yearly.

Workforce dynamics are significant as well. The extent of staff training is presented in the Global Competitiveness Report (GCR). It is measured with a survey question “In your country, to what extent do companies invest in training and employee development?” and the answers range between 1 = not at all and 7 = to a great extent. In Figure 3.13 average questionnaire answers are given according to GCR. Turkey has low values for staff training compared to most of the countries (Schwab, 2019).

The shortage of a skilled workforce is considered a significant problem in several countries (Construction Blueprint Consortium, 2020). It is also one of the weaknesses of the Turkish construction industry (Ünal, 2020). Improvements in vocational education and training, apprenticeship, and training for trades are proposed to enhance workforce quality (Construction Blueprint Consortium, 2020).

In the report of Construction Blueprint Consortium (2020), it is stated that the image of the construction industry should be improved by increasing the quality of the work, providing better employment opportunities, better health and safety, encouraging women and young people to take part in the construction industry, incorporating technological advancements and taking support from government, universities and other stakeholders.

3.2.1.4. Technological Factors. Technological factors represent the use of knowledge to create new technologies (Rothaermel, 2017). After inspection of the global reports "information and communication technologies (ICTs) use" and "Foreign direct investment (FDI) net inflows" are considered to explain the technological factors.

Information and communication technologies (ICTs) use is a composite index that is composed of "percentage of individuals using the internet; fixed (wired)-broadband internet subscriptions per 100 inhabitants; and active mobile-broadband subscriptions per 100 inhabitants." (Cornell University *et al.*, 2020). This index is given in GII and ranges between 0 and 100. In Figure 3.14, it can be seen that access to the internet has increased over the years.

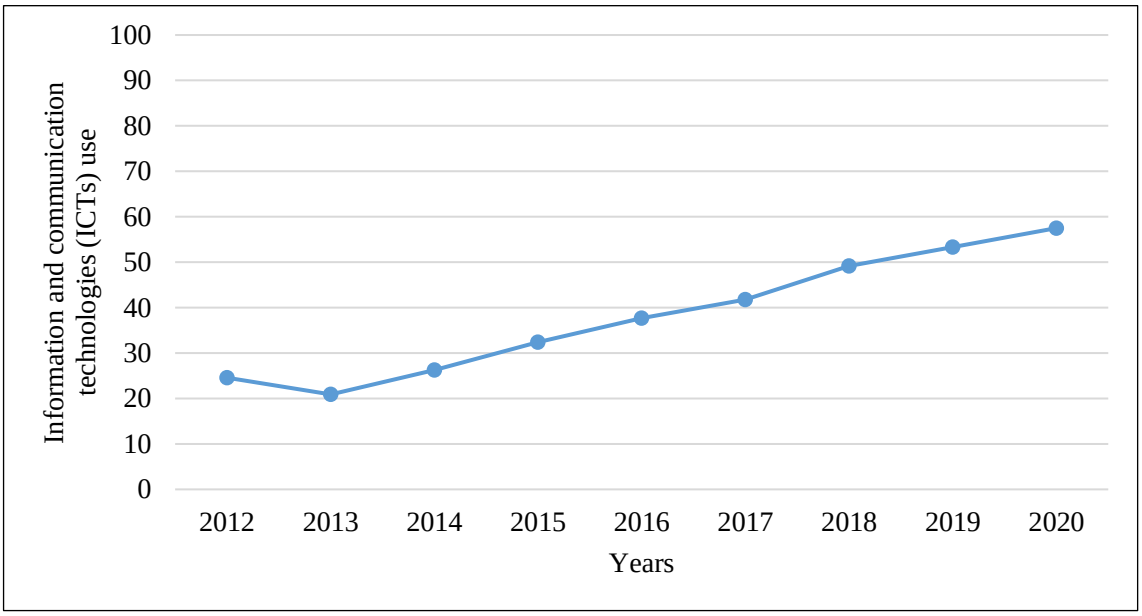

Figure 3.14. Information and communication technologies (ICTs) use index for Turkey, yearly.

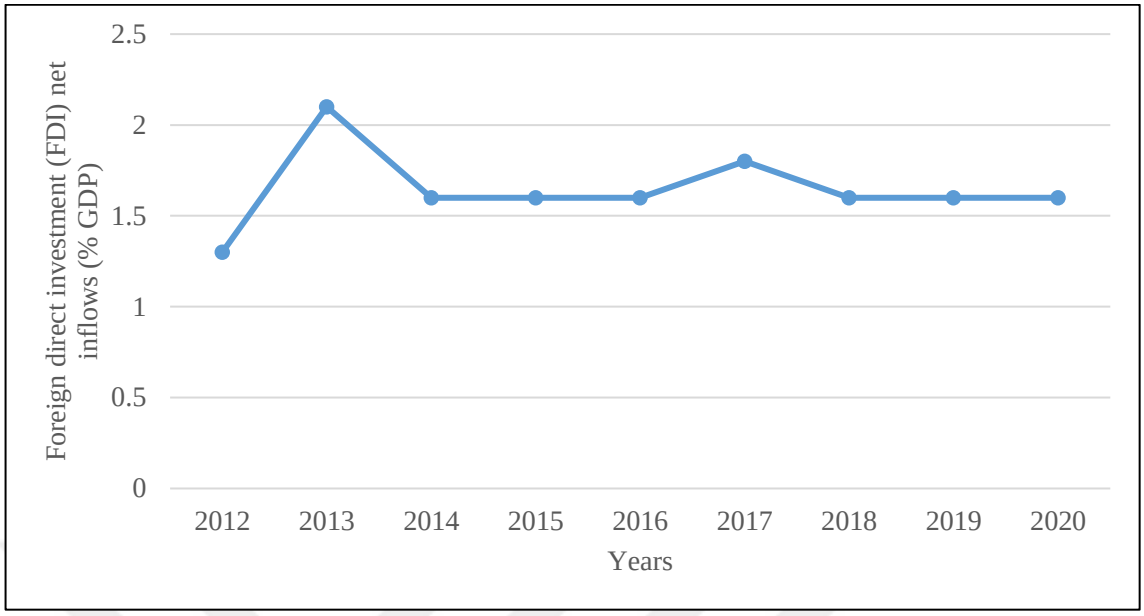

Figure 3.15. Foreign direct investment net inflows (% GDP) of Turkey, yearly.

Foreign direct investment (FDI) net inflows is calculated as "the average of the most recent three years of net inflows of investment to acquire a lasting management interest in an enterprise operating in an economy other than that of the investor is divided by GDP." (Cornell University *et al.*, 2020). Foreign direct investment net inflows can be seen in Figure 3.15 according to GII. Considering the sectoral distribution of FDI between 2003 and 2020, the highest shares were belonged to finance and manufacturing industries which are 33% and 24%, respectively, where the construction industry had a share of 3% (Residency of the Republic of Turkey Investment Office, 2021).

There is an increasing number of technological developments that may impact construction industry processes (Construction Blueprint Consortium, 2020). The construction industry is one of the most traditional sectors. However, there is an inclination towards technological advancements in the construction industry as well. According to Construction Blueprint Consortium (2020), investments in research and development, digitalization and industrialization are critical to enhancing the productivity of the construction industry. Digitalization is also critical for competitiveness. Technologies such as Building Information Modelling (BIM), cloud-based systems, simulators (virtual reality, augmented reality, etc.), modular construction and new construction materials gain increasing awareness and they are expected to be more significant in the near future

(Construction Blueprint Consortium, 2020). However, since the construction industry is sensitive to economic instability, companies are not prone to invest in technological advancements (Construction Blueprint Consortium, 2020). Besides that, cost of purchase and need for training staff are some barriers to implement technological advancements. Although there are some attempts to use technological advancements, they have not been widely applied in the Turkish construction industry (Ünal, 2020).

3.2.1.5. Environmental Factors. Environmental factors include issues related to the environment, and sustainable growth (Rothaermel, 2017). "Environmental performance index" is a measure that includes "32 performance indicators across 11 issue categories covering environmental health and ecosystem vitality." (Cornell University *et al.*, 2020). It is given in GII and ranges between 0 and 100. As can be seen in Figure 3.16 Turkey has low values in environmental performance and they follow a decreasing trend after 2017.

The construction industry is one of the major industries that contributes to environmental impacts. The use of natural resources (e.g., water, energy) in the construction industry which contributes to the shortage of resources is a significant concern. Climate change is another issue that may pose risks to the environment. Hence, the construction industry may play an important role to mitigate and eliminate the negative effects of climate change (Construction Blueprint Consortium, 2020).

Construction Blueprint Consortium (2020) report highlights some important topics in the construction industry which are energy efficiency, circular economy, environmentally friendly and sustainable solutions. These kinds of solutions should be supported by the government through tax incentives, legislation and required technology (Construction Blueprint Consortium, 2020). In the Turkish construction industry, there are some initiatives. Turkish Green Building Council (ÇEDBİK) is a pioneer organization that aims to implement principles of sustainability in the Turkish construction industry. Further, some certification systems have been followed in Turkey. Leadership in Energy and Environmental Design (LEED) is one of the most commonly used green building rating and certification systems. Turkey was ranked as the sixth country in terms of LEED-certified gross area by U.S. Green Building Council in 2019 (USGBC, 2019).

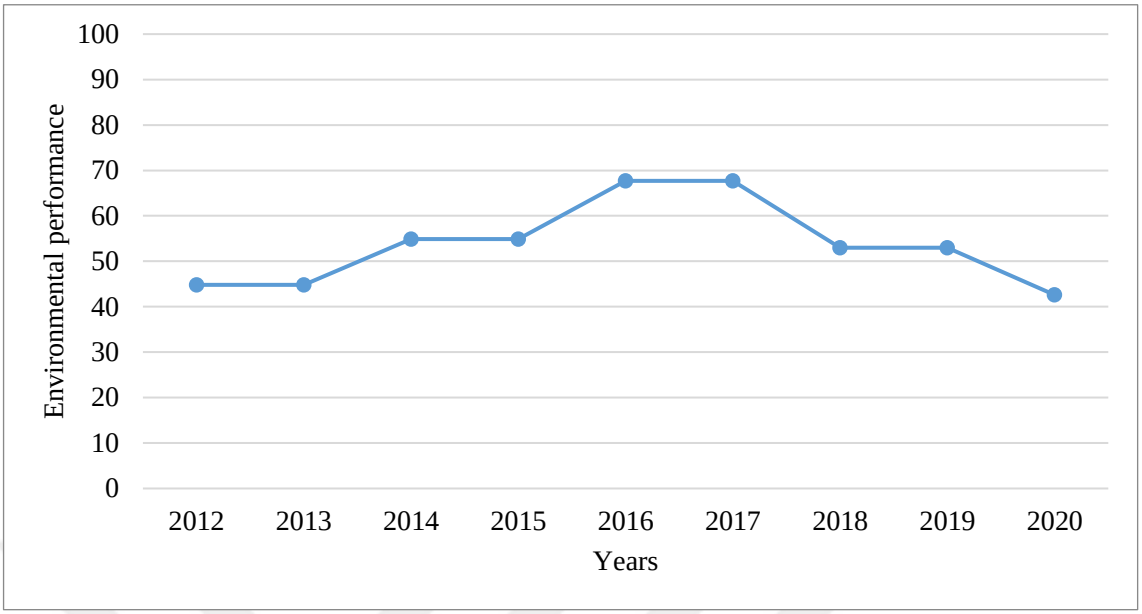

Figure 3.16. Environmental performance index of Turkey, yearly.

3.2.1.6. Legal Factors. Legal factors are related to outcomes of political factors such as regulations and laws (Rothaermel, 2017). Global reports present some indicators of legal factors. The regulatory quality index reflects "perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private-sector development." (Cornell University *et al.*, 2020). It is presented in GII and ranges between 0 and 100. According to Figure 3.17, Turkey has low regulatory quality respectively which follows a decreasing trend.

Efficiency of the legal framework in challenging regulations is presented in GCR. It is measured with a survey question "In your country, how easy is it for private businesses to challenge government actions and/or regulations through the legal system?" through a scale ranging between 1 = extremely difficult and 7 = extremely easy. As can be seen in Figure 3.18, in recent years, the legal framework seems to be less efficient, following a decreasing trend. Turkey has lower values compared to other countries (Schwab, 2019).

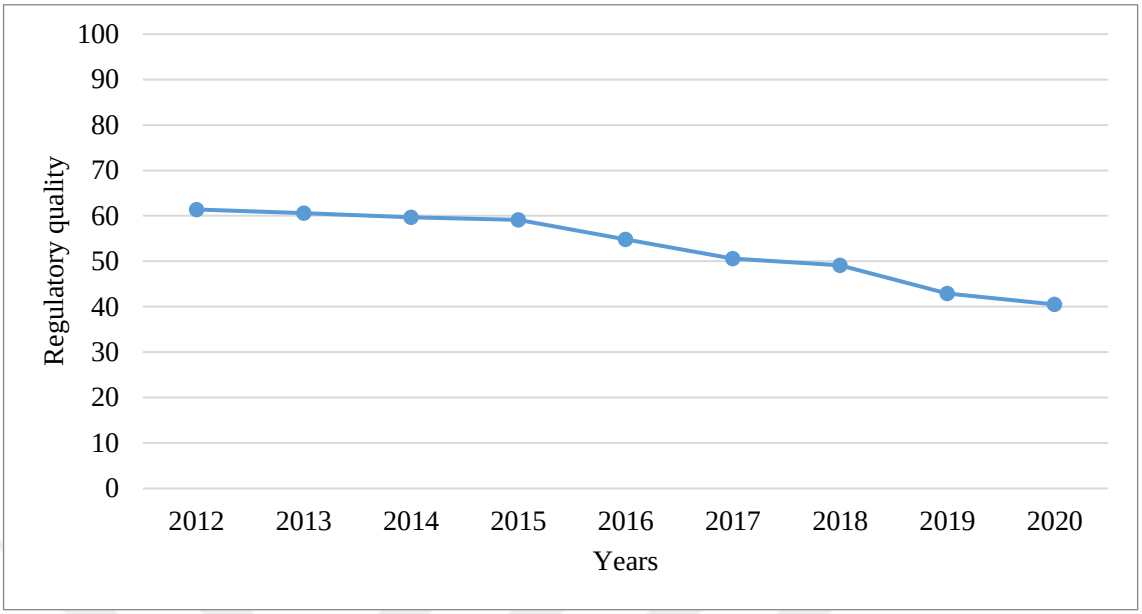

Figure 3.17. Regulatory quality index of Turkey, yearly.

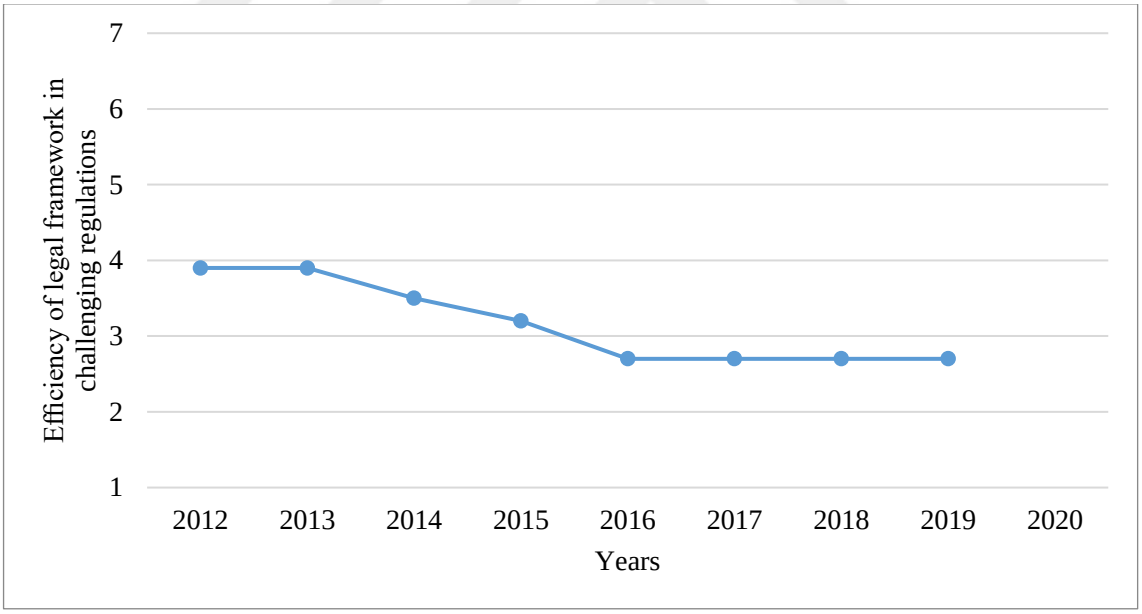

Figure 3.18. Efficiency of the legal framework in challenging regulations in Turkey, yearly.

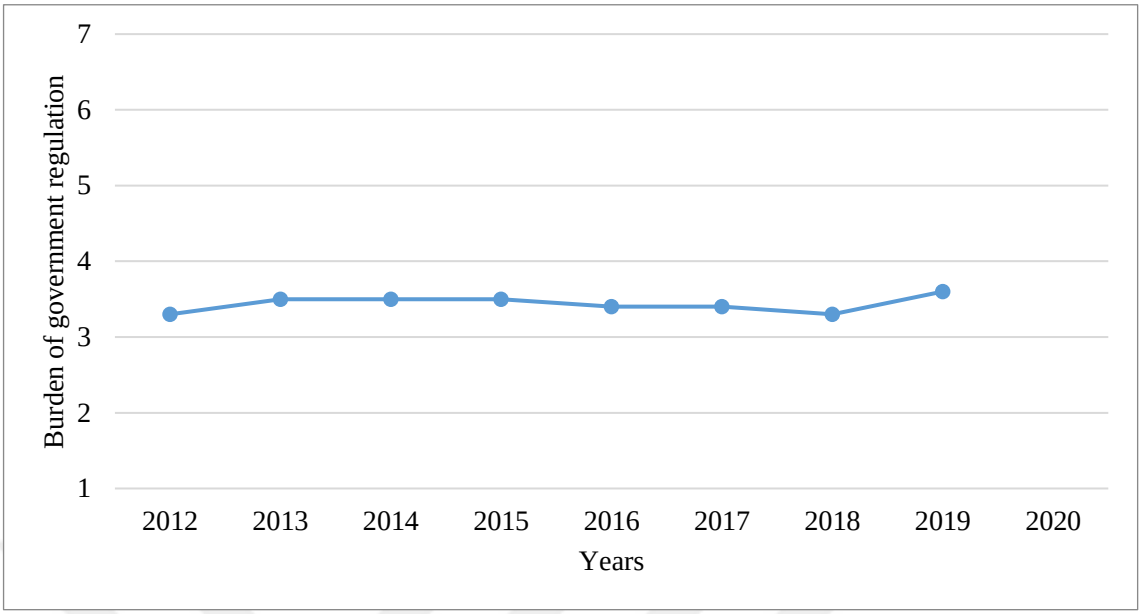

Figure 3.19. The burden of government regulation in Turkey, yearly.

The burden of government regulation is provided in GCR. It is evaluated with a survey question "In your country, how burdensome is it for companies to comply with public administration's requirements (e.g., permits, regulations, reporting)?" with a measurement scale where 1 = extremely burdensome and 7 = not burdensome at all. According to Figure 3.19, government regulations seem to be moderately burdensome.

Legal requirements should be supportive, not hindering. Legislations are important to specify standards for energy efficiency, sustainability, circular economy, etc. (Construction Blueprint Consortium, 2020). In Turkey, some regulations such as tax regulations limit the potential of the construction industry (Ünal, 2020).

3.2.1.7. The Threat of New Entrants. The threat of new entrants is the likelihood of entering new competitors into the construction industry (Ho, 2015). This factor is high when economies of scale, differentiation, capital requirements, and customer switching costs are low (Ho, 2015). Besides, the power of present companies and government policies may affect this factor.

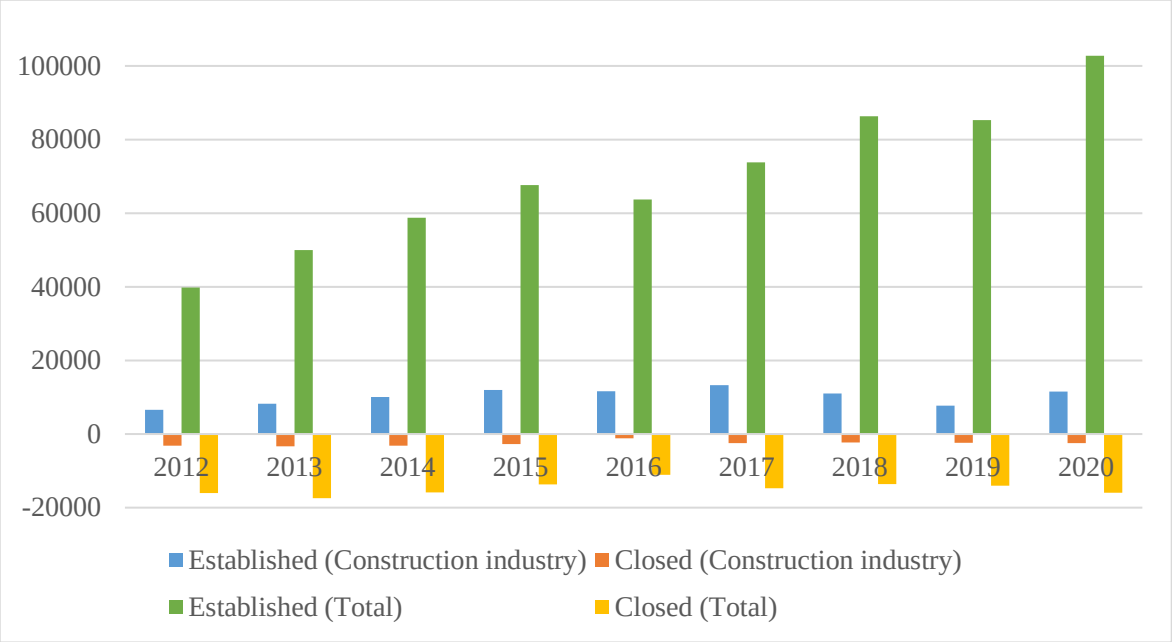

Figure 3.20. The number of established and closed companies in the construction industry and total, yearly.

Investigating the number of companies established and closed may help to understand the entry and exit barriers to the construction industry in Turkey. According to data extracted from the Union of Chambers and Commodity Exchanges of Turkey (2021), the number of established and closed companies is given in Figure 3.20. When the total number of newly established companies is considered, there is an increasing trend (except 2016) while the total number of closed companies is relatively stable. On the other hand, the number of newly established construction companies increases until 2017 (which covers 18% of the total number), then it decreases (to 11% of the total number). This may be an indicator that the likelihood of new companies entering the construction industry is relatively low compared to previous years.

In Turkey, the construction industry is one of the most open industries to enter, hence, the threat of new entrants was high (Cengiz *et al.*, 2019). On the other hand, the construction industry had some problems related to the high number of companies, unbalance of supply, demand and price, and financial structure (İMSAD, 2020). Due to these problems, the construction industry declined significantly in recent years. Hence, this threat may be less powerful in the near future.

3.2.1.8. Rivalry among Competitors. This force refers to "competitive actions among competitors in the construction industry" (Ho, 2015). This force is high when there is a high number of companies or equally balanced companies, low or negative industry growth rate, low entry and exit barriers and lack of differentiation (Rothaermel, 2017; Ho, 2015). The construction industry is characterized by a high number of small and medium-sized companies and the differentiation level is low (Ho, 2015). Along with the low growth rate and other characteristics of the industry, the Turkish construction industry is expected to have an intense competition level (Cengiz *et al.*, 2019).

3.2.1.9. COVID-19. Along with these environmental changes, the coronavirus disease (COVID-19) pandemic should also be mentioned since it affected the Turkish construction industry severely. Being one of the most unexpected events, coronavirus disease (COVID-19) has emerged in China at the end of 2019. COVID-19 spread rapidly all over the world and was characterized as a pandemic in 2020 (WHO, 2021). The pandemic created an unstable, unpredictable and highly volatile environment (İMSAD, 2020). It caused serious social, environmental and economic consequences (Tamtam and Tourabi, 2020). Since the world is more integrated, the COVID-19 pandemic adversely affected all countries and Turkey as well. Fernandes (2020) forecasted the effect of the pandemic on different countries considering several scenarios. In general, global recession was predicted, however, the degree to which countries are affected depends on measures taken. Countries applied some restrictions such as the closure of workplaces, quarantine for travelers, mandatory usage of masks, working from home and cancellation of mass gathering events (ECDC, 2021).

The composition of sectors in the country was another factor that specifies the level of impact (Fernandes, 2020). Most of the sectors were affected by the pandemic. However, service-oriented sectors were expected to be affected more than agriculture or industry sectors (Fernandes, 2020). Like other industries, the construction industry has been affected by the pandemic. Several studies showed the consequences of the pandemic on the construction industry such as suspension of projects, disruption of the supply chain, time and cost overruns and labor shortage (Biswas *et al.*, 2021; Gamil and Alhagar, 2020). Besides that, in Turkey, the economic problems before the pandemic had worsened the situation. The construction industry had been challenging with problems due to its dynamics before the pandemic. Hence the effect of the pandemic was intensified according to the report of

İMSAD (2020). The construction industry is expected to recover in a longer period due to its dynamics (İMSAD, 2020).

After the COVID-19 pandemic, most of the organizations were obliged to seek new models due to its adverse impact (Francis, 2020). At this point, agility becomes crucial for organizations in order to survive. The COVID-19 pandemic emphasized the significance of agility (Tamtam and Tourabi, 2020). Panitsettakorn and Ongkunaruk (2021) presented a case study showing actions of an agile company during the COVID-19 pandemic. They revealed several problems and their solutions to improve supply chain agility. The COVID-19 pandemic is one of the significant events that necessitate the agility of organizations. Hence, along with other uncertainties and volatility in the environment and dynamics of the construction industry, organizational agility is required for Turkish construction companies.

To conclude up, in this section, macroenvironmental changes are analyzed using the PESTEL framework. Further, the competitiveness of the Turkish construction industry was examined. Considering environmental changes was significant because agility is dependent on the environmental change as per most of the agility definitions (Singh *et al.*, 2013). Organizational agility emphasizes managing change (Walter, 2021; Overby *et al.*, 2006). Hence, the determination of agility drivers is an essential keystone to evaluate agility. Several studies proposed a direct and positive impact of turbulence on organizational agility (Walter, 2021; Vázquez-Bustelo *et al.*, 2007). However, if the environmental conditions are not dynamic and turbulent, organizational agility may become a costly solution (Walter, 2021; Teece *et al.*, 2016). Therefore, environmental changes are inspected according to global reports and statistics from official websites. The effect of these indicators on the Turkish construction industry is discussed. Most of the indicators showed that Turkey's macroenvironment is changing, dynamic, complex and competitive which impacts the construction industry. Several studies supported these findings of the environment of the construction industry. In the case study of Ribeiro and Fernandes (2010), most of the respondents stated that the construction industry environment is unpredictable because of some factors like a volatile and competitive market, customer demand changes, and technological changes. Further, COVID-19 pandemic intensified the effect of changes.

Considering the nature of the Turkish construction industry and the effect of environmental changes, the need for organizational agility is emphasized for Turkish construction companies in order to respond to changes. Environmental changes can be considered as the main drivers of organizational agility. To manage environmental changes, companies tend to become more flexible and adaptable (Meinhardt *et al.*, 2018). Hence, the significant impact of environmental factors on the construction industry can be proposed. Based on the given background information, the first hypothesis proposed the significant and positive effect of environmental changes on the organizational agility in Turkish construction companies.

H1a. *The effect of political changes on the construction industry has a significant and positive impact on organizational agility of construction companies.*
H1b. *The effect of economic changes on the construction industry has a significant and positive impact on organizational agility of construction companies.*
H1c. *The effect of sociocultural changes on the construction industry has a significant and positive impact on organizational agility of construction companies.*
H1d. *The effect of technological changes on the construction industry has a significant and positive impact on organizational agility of construction companies.*
H1e. *The effect of environmental changes on the construction industry has a significant and positive impact on organizational agility of construction companies.*
H1f. *The effect of legal changes on the construction industry has a significant and positive impact on organizational agility of construction companies.*
H1g. *The effect of the threat of new entrants on the construction industry has a significant and positive impact on organizational agility of construction companies.*
H1h. *The effect of rivalry among competitors on the construction industry has a significant and positive impact on organizational agility of construction companies.*

To measure the perception regarding the impact of environmental changes on the Turkish construction industry, the items in Table 3.1 were added to the questionnaire. Environmental change factors are considered as separate variables. Because they represent distinct dimensions of the environment. For example, in studies of Phan, (2021) and Khalid *et al.* (2020) PESTEL items were considered separately, as well. Similarly, Öztürk İlhan (2007) considered environmental changes as distinct factors.

Table 3.1. Environmental change questionnaire items.

Code	Questionnaire item
Env1	Political changes (actions of government bodies etc.)
Env2	Economic changes (growth, interest, inflation, unemployment rates, etc.)
Env3	Sociocultural changes (demographic trends, culture and values, etc.)
Env4	Technological changes (newly introduced technologies, etc.)
Env5	Environmental/ecological changes
Env6	Legal changes (laws, regulations, etc.)
Env7	The threat of new entrants to the Turkish construction industry
Env8	Rivalry among existing competitors in the Turkish construction industry

3.2.2. Organizational Agility

Organizational agility is a "latent and multidimensional construct" (Charbonnier-voirin, 2011, p. 123). Considering definitions of organizational agility and models developed, the main capabilities of agile organizations have been emphasized frequently. Hence organizational agility is proposed to be measured with "sensing, responsiveness, flexibility and competency" based on the definitions and models in the literature.

Table 3.2. Organizational agility subconstructs, their definitions and references.

Organizational agility constructs	Definition
Sensing (Gunsberg et al., 2018; Žitkienė and Deksnys, 2018; Nafei, 2016; Teece et al., 2016; Dove, 2001, 2005a; Overby et al., 2005)	The capability to monitor, identify and analyze changes, and to detect opportunities and threats.
Responsiveness (Walter, 2021; Darvishmotevali and Tajeddini, 2020; Žitkienė and Deksnys, 2018; Harraf et al., 2015; Charbonnier-voirin, 2011; Almahamid et al., 2010; Sherehiy et al., 2007; Zhang and Sharifi, 2007; Overby et al., 2005; Crocitto and Youssef, 2003; Khoshsima, 2003)	The capability to quickly respond to changes reactively and/or proactively and recover from effects of changes.
Flexibility (Walter, 2021; Darvishmotevali and Tajeddini, 2020; Ezcan et al., 2020; Carvalho et al., 2020; de Oliveira et al., 2012; Adler, 2012; Ribeiro and Fernandes, 2010; Almahamid et al., 2010; Sherehiy et al., 2007; Zhang and Sharifi, 2007; Lin et al., 2006; Crocitto and Youssef, 2003; Sharifi and Zhang, 1999)	The capability to reconfigure the resources, reorganize the processes and adapt to changing conditions.
Competency (Walter, 2021; Ezcan *et al.*, 2020; Koçyiğit and Akkaya, 2020; Sud-on *et al.*, 2014; Almahamid *et al.*, 2010; Eshlaghy *et al.*, 2010; Zhang and Sharifi, 2007; Lin *et al.*, 2006; Sharifi and Zhang, 1999, 2001)	The capability to achieve the organization's goals efficiently and effectively such as time, cost, quality and performance.

Table 3.3. Organizational agility questionnaire items.

	Code	Questionnaire item
Sensing	Sens1	The organization monitors internal and external data. (Walter, 2021; Ezcan et al., 2020; Tamtam and Tourabi, 2020; Adler, 2012; Charbonnier-voirin, 2011; Sherehiy et al., 2007; Dove, 2005b)
	Sens2	The organization turns information into actionable knowledge. (Dove, 2005b)
	Sens3	The organization fully understands and analyses changes (such as market, customer requirements, technology, social, legal and organization's internal changes). (Walter, 2021; Francis, 2020; Gunsberg *et al.*, 2018; Nafei, 2016; Axelsson and Blomqvist, 2012; Alzoubi *et al.*, 2011; Tsai *et al.*, 2008; Sharifi and Zhang, 2001; Meredith and Francis, 2000)
	Sens4	The organization detects unrecognized opportunities and threats. (Darvishmotevali *et al.*, 2020; Francis, 2020; Nafei, 2016; Harraf *et al.*, 2015; Charbonnier-voirin, 2011; Sherehiy *et al.*, 2007)
Responsiveness	Resp1	The organization is able to give immediate reactions to changes, take decisions and implement them efficiently and quickly. (Darvishmotevali *et al.*, 2020; Ezcan *et al.*, 2020; Nafei, 2016; Najrani, 2016; Charbonnier-voirin, 2011; Sharifi and Zhang, 1999, 2001)
	Resp2	The organization detects tendencies earlier proactively and optimizes the organizational strategy accordingly. (Najrani, 2016; Arteta and Giachetti, 2004; Dove, 2001; Zhang and Sharifi, 2000)
	Resp3	The organization is able to recover from and deal with changes. (Ezcan *et al.*, 2020; Zhang and Sharifi, 2007; Sharifi and Zhang, 2001)
	Resp4	The organization takes advantage of opportunities, took advantage of opportunities recently (by developing new projects in a different area, sector, product type, type of partnership, etc.). (Storm Consulting, 2021; Francis, 2020; Chakravarty *et al.*, 2013; Sharifi and Zhang, 2001)
	Resp5	The organization mitigates threats, mitigated threats (effect of the pandemic, economic instability, etc.) recently. (Francis, 2020; Tallon and Pinsonneault, 2011)
Flexibility	Flex1	The organization has a set of resources (multi-skilled human resources, a variety of investments, mixed-use technology, etc.) and is able to reconfigure and reallocate them easily as circumstances require. (Carvalho *et al.*, 2020; Tiwari and Tiwari, 2019; Gunsberg *et al.*, 2018; Nafei, 2016; Najrani, 2016; Adler, 2012; Alzoubi *et al.*, 2011; Charbonnier-voirin, 2011; Eshlaghy *et al.*, 2010; Sherehiy *et al.*, 2007)
	Flex2	The organization is able to reorganize the processes and their relationships in situations that may necessitate this action. (Francis, 2020; Tamtam and Tourabi, 2020; Dove, 2001).
	Flex3	The organization is able to adapt to the changing conditions. (Francis, 2020; Tiwari and Tiwari, 2019; Najrani, 2016; Wendler, 2014; Trinh-Phuong *et al.*, 2012)
	Flex4	The organization develops a range of possible solutions (pre-designed or just-in-time) to respond to changes. (Ezcan *et al.*, 2020; Alzoubi *et al.*, 2011)
Competency	Comp1	The organization is able to achieve the organization’s goals such as time, cost and quality requirements. (Tamtam and Tourabi, 2020; Almahamid *et al.*, 2010; Zhang and Sharifi, 2007; Lin *et al.*, 2006; Overby *et al.*, 2005; Sharifi and Zhang, 2001)
	Comp2	The organization has operational efficiency and effectiveness. (Tsai *et al.*, 2008; Sharifi and Zhang, 2001)
	Comp3	The organization is able to identify and eliminate non-value adding processes. (Tamtam and Tourabi, 2020; Tiwari and Tiwari, 2019; Triaa *et al.*, 2016; Vinodh *et al.*, 2012)

In Table 3.2, subconstructs representing organizational agility can be seen along with their definition in the context of the study and relevant references. In Table 3.3, the questionnaire items used to measure organizational agility are presented along with relevant references. Further, a questionnaire item of "What is the level of organizational agility of your company according to your perception?" according to a 5-point Likert scale from very low to very high is added. It is used to measure the organizational agility perception of respondents in their companies, similar to the study of Sharifi and Zhang (2001).

3.2.2.1. Sensing. An agile organization should sense its internal and external environment, first. Sensing is referred to as perceiving, anticipating (Ezcan *et al.*, 2020; Sharifi *et al.*, 2001; Sharifi and Zhang, 1999), awareness (Gunsberg et al., 2018; Dove, 2005b), market analysis (Harraf *et al.*, 2015), wide-deep scanning (Bessant *et al.*, 2002; Meredith and Francis, 2000) and knowledge management (Dove, 2001) in other studies. Even though most of the models considered sensing as a part of responsiveness (Zhang and Sharifi, 2000, 2007; Sharifi *et al.*, 2001), this study examines sensing as a separate subconstruct similar to the studies of Dove (2005b) and Overby *et al.* (2005). Because it is important, first, to monitor and identify changes to respond and adapt to changes successfully (Sherehiy *et al.*, 2007). Dove (2005b) explains sensing as awareness or knowledge management. In knowledge management, observing internal and external data is essential. However, monitoring this raw data is not enough, it should further be evaluated and filtered according to its accuracy, relevancy, content and timeliness. Then, this information should be shared with relevant people and converted into applicable knowledge (Dove, 2005b). In the context of this study, sensing is defined as the capability to monitor, identify and analyze changes, and to detect opportunities and threats (Nafei, 2016; Teece *et al.*, 2016; Zhang and Sharifi, 2007).

3.2.2.2. Responsiveness. Responsiveness is mentioned as the main capability in almost all organizational agility studies. Responsiveness involves several abilities. In this study, it is defined as the capability to quickly respond to changes reactively and/or proactively and recover from effects of changes (Najrani, 2016; Sherehiy *et al.*, 2007; Zhang and Sharifi, 2000). In several studies, speed is mentioned as a characteristic of response. Hence, rather than considering speed as a separate subconstruct, it is incorporated into the responsiveness construct, similar to studies of Ezcan *et al.* (2020) and Almahamid *et al.* (2010). Agile organizations take immediate actions in the shortest possible time and take decisions

efficiently and quickly (Darvishmotevali *et al.*, 2020; Ezcan *et al.*, 2020; Nafei, 2016; Najrani, 2016; Charbonnier-voirin, 2011; Sharifi and Zhang, 1999, 2001). Being reactive is responding to changes after they are recognized and being proactive is identifying new tendencies in the market early and optimizing the organizational strategy, accordingly (Najrani, 2016; Zhang and Sharifi, 2007). Besides, responsiveness necessitates taking advantage of opportunities and mitigating threats that are identified in the environment (Francis, 2020; Chakravarty *et al.*, 2013; Tallon and Pinsonneault, 2011; Sharifi and Zhang, 2001). Responsiveness also includes recovering from the effects of changes (Ezcan *et al.*, 2020; Sharifi and Zhang, 1999).

3.2.2.3. Flexibility. Another frequently mentioned agility capability is flexibility. It has a broad meaning covering flexibility of product volume, product model, resources, people and organization (Zhang and Sharifi, 2007). However, some of these aspects are related to the manufacturing industry. Hence, this study focuses on flexibility in resources (Ezcan *et al.*, 2020; Najrani, 2016; Worley and Lawler, 2010; Sharifi and Zhang, 1999), processes (Carvalho *et al.*, 2020; Ezcan *et al.*, 2020; Kumar and Motwani, 1995) and organization (Sharifi and Zhang, 1999). In this study, flexibility is defined as the capability to reconfigure the resources; reorganize the processes to adapt to changing conditions.

3.2.2.4. Competency. Agile organizations are also specified to have basic business competencies (Zhang and Sharifi, 2007). Competency is the ability to satisfy an organization's goals (Lin *et al.*, 2006). Organizational agility requires competency in terms of cost (Darvishmotevali and Tajeddini, 2020; Tiwari and Tiwari, 2019; Almahamid *et al.*, 2010; Tsai *et al.*, 2008; Crocitto and Youssef, 2003), quality (Darvishmotevali and Tajeddini, 2020; Tsai *et al.*, 2008; Sherehiy *et al.*, 2007; Crocitto and Youssef, 2003; Yusuf *et al.*, 1999), time (Tsai *et al.*, 2008) and leanness (Tiwari and Tiwari, 2019; Ribeiro and Fernandes, 2010). In this study, competency is similarly defined as the capability to achieve efficiently and effectively an organization's goals such as time, cost, quality and performance (Almahamid *et al.*, 2010; Tsai *et al.*, 2008; Zhang and Sharifi, 2007; Lin *et al.*, 2006).

3.2.3. Enablers of Organizational Agility

Several agility enablers have been defined in the literature; however, no consensus has been reached for a final list. Hence, mostly cited agility enablers were considered in the model. While evaluating agility enablers, interviews were taken into account and items that are specific to the manufacturing industry were not included. Instead, construction industry companies were considered. After the determination of organizational agility enablers, interrelations and dependence between them were also considered (Walter, 2021). In order to measure organizational agility enablers, the used items are presented in Table 3.4.

Table 3.4. Organizational agility enablers questionnaire items.

	Code	Questionnaire item
Flat structure	Flat	The organizational structure is flat and horizontal with less hierarchy. (Koçyiğit and Akkaya, 2020; Tamtam and Tourabi, 2020; Carvalho *et al.*, 2020; Žitkienė and Deksnys, 2018; Nijssen and Paauwe, 2012; Vinodh *et al.*, 2010, 2012; Sherehiy *et al.*, 2007; Zhang and Sharifi, 2007; Owen *et al.*, 2006; Crocitto and Youssef, 2003)
Change culture	Orgc1	The organization has a change culture. (Geiger *et al.*, 2020; Carvalho *et al.*, 2020; Surbakti *et al.*, 2019; Project Management Institute, 2017b; Najrani, 2016; Teece *et al.*, 2016; Tseng and Lin, 2011; Bottani, 2010; Worley and Lawler, 2010; Tsai *et al.*, 2008; Shih and Lin, 2002; Yusuf *et al.*, 1999)
	Orgc2	The organizational culture supports continuous improvement. (Geiger *et al.*, 2020; Tamtam and Tourabi, 2020; Gunsberg *et al.*, 2018; Eshlaghy *et al.*, 2010; Vinodh *et al.*, 2010; Sherehiy *et al.*, 2007; Yusuf *et al.*, 1999)
	Orgc3	The organization has a culture of innovation that supports experimentation and innovative ideas. (Pulakos *et al.*, 2019; Gunsberg *et al.*, 2018; Holbeche, 2018; Harraf *et al.*, 2015; Adler, 2012; Vinodh *et al.*, 2012; Eshlaghy *et al.*, 2010; Sherehiy *et al.*, 2007; Vázquez-Bustelo *et al.*, 2007; Sharifi and Zhang, 2001; Sharifi *et al.*, 2001)
Organizational learning	Orgl1	The organization is skilled to transform experience and knowledge gained into projects, services, and new strategies. (Najrani, 2016; Alzoubi *et al.*, 2011; Worley and Lawler, 2010; Owen *et al.*, 2006)
	Orgl2	The organization cares skill development and knowledge sharing. (Triaa *et al.*, 2016; Charbonnier-voirin, 2011; Tseng and Lin, 2011; Tsai *et al.*, 2008; Shih and Lin, 2002)
	Orgl3	The organization provides continuous training, education and development. (Tamtam and Tourabi, 2020; Geiger *et al.*, 2020; Surbakti *et al.*, 2019; Shin *et al.*, 2015; Vinodh *et al.*, 2012; Sherehiy *et al.*, 2007; Vázquez-Bustelo *et al.*, 2007; Zhang and Sharifi, 2007; Tsourveloudis and Valavanis, 2002; Sharifi *et al.*, 2001; Yusuf *et al.*, 1999)

Table 3.4. Organizational agility enablers questionnaire items. (cont.)

People	Peop1	The organization employs multi-skilled and flexible human resources. (Tamtam and Tourabi, 2020; Tiwari and Tiwari, 2019; Triaa *et al.*, 2016; Samantra *et al.*, 2015; Wendler, 2014; Tseng and Lin, 2011; Vinodh *et al.*, 2010; Bottani, 2010; Eshlaghy *et al.*, 2010; Ribeiro and Fernandes, 2010; Tsai *et al.*, 2008; Shih and Lin, 2002; Bessant *et al.*, 2002; Meredith and Francis, 2000; Yusuf *et al.*, 1999; Kumar and Motwani, 1995)
	Peop2	In the organization, employees are empowered and trusted, they have the authority and power to make decisions individually. (Geiger *et al.*, 2020; Surbakti *et al.*, 2019; Gunsberg *et al.*, 2018; Samantra *et al.*, 2015; Vinodh *et al.*, 2010, 2012; Tseng and Lin, 2011; Alzoubi *et al.*, 2011; Charbonnier-voirin, 2011; Bottani, 2010; Tsai *et al.*, 2008; Sherehiy *et al.*, 2007; Zhang and Sharifi, 2007; Owen *et al.*, 2006; Shih and Lin, 2002; Yusuf *et al.*, 1999)
	Peop3	In the organization, teamwork is clearly observed. (Koçyiğit and Akkaya, 2020; Tamtam and Tourabi, 2020; Surbakti *et al.*, 2019; Triaa *et al.*, 2016; Shin *et al.*, 2015; Eshlaghy *et al.*, 2010; Vázquez-Bustelo *et al.*, 2007; Zhang and Sharifi, 2007; Owen *et al.*, 2006; Sharifi *et al.*, 2001)
	Peop4	In the organization, teams are cross-functional and self-managed. (Schwaber and Sutherland, 2020; Tamtam and Tourabi, 2020; Carvalho *et al.*, 2020; Geiger *et al.*, 2020; Tiwari and Tiwari, 2019; Samantra *et al.*, 2015; Nejatian and Zarei, 2013; Vinodh *et al.*, 2012; Tseng and Lin, 2011; Bottani, 2010; Tsai *et al.*, 2008; Sherehiy *et al.*, 2007; Vázquez-Bustelo *et al.*, 2007; Shih and Lin, 2002; Yusuf *et al.*, 1999)
Technology	Tech1	The organization is aware of current technologies. (Samantra *et al.*, 2015; Tseng and Lin, 2011; Bottani, 2010; Tsai *et al.*, 2008; Shih and Lin, 2002; Yusuf *et al.*, 1999)
	Tech2	The organization uses an adequate and right mix of technology in design/production/construction processes. (Tamtam and Tourabi, 2020; Zhang and Sharifi, 2007; Sharifi and Zhang, 2001)
	Tech3	The organization uses information and communication technology (Vinodh *et al.*, 2012; Tseng and Lin, 2011; Tsai *et al.*, 2008; Shih and Lin, 2002)
External relations	Ext1	The organization has close and trust-based relationships with suppliers. (Geiger *et al.*, 2020; Tiwari and Tiwari, 2019; Samantra *et al.*, 2015; Vinodh *et al.*, 2012; Tseng and Lin, 2011; Bottani, 2010; Tsai *et al.*, 2008; Sherehiy *et al.*, 2007; Vázquez-Bustelo *et al.*, 2007; Shih and Lin, 2002; Sharifi *et al.*, 2001; Yusuf *et al.*, 1999)
	Ext2	The organization cooperates with other firms (suppliers, customers, competitors, etc.). (Mishra *et al.*, 2014; Lin *et al.*, 2006; Yang and Li, 2002; Sharifi and Zhang, 2001)
	Ext3	The organization communicates and develops relations with customers. (Surbakti *et al.*, 2019; Vinodh *et al.*, 2012; Tseng and Lin, 2011; Tsai *et al.*, 2008; Sherehiy *et al.*, 2007; Zhang and Sharifi, 2007; Sharifi *et al.*, 2001)

3.2.3.1. Flat Organizational Structure. Agile organizations should have an adaptable organizational structure (Žitkienė and Deksnys, 2018). Organic organizational structure provides decentralized decision making and less specialization and formalization. There is less hierarchy and the control mechanism is not strict (Donaldson, 2001). Ribeiro and

Fernandes (2010) emphasized that flexible and less hierarchical organizational structure enables cooperation and communication in construction companies. The characteristics of organic organizational structure are considered as important enabling factors of organizational agility in most of the studies (Carvalho *et al.*, 2020; Žitkienė and Deksnys, 2018; Axelsson and Blomqvist, 2012; Vinodh *et al.*, 2012; Bottani, 2010; Eshlaghy *et al.*, 2010; Tsai *et al.*, 2008; Sherehiy *et al.*, 2007; Sharifi *et al.*, 2001).

A large portion of the studies has a consensus that the organizational structure should be flat, horizontal with fewer hierarchy levels rather than being vertical with numerous hierarchy levels (Menon and Suresh, 2021; Tamtam and Tourabi, 2020; Muduli, 2017; Sindhwani and Malhotra, 2017; Conforto *et al.*, 2014; Nijssen and Paauwe, 2012; Vinodh *et al.*, 2010; Sherehiy *et al.*, 2007; Crocitto and Youssef, 2003). Dove (2001) advocated that response-ability can be achieved through an organizational structure that allows change. Agility requires enhanced relationships rather than having traditional hierarchical levels (Crocitto and Youssef, 2003). Having few levels of hierarchy creates a potential for agility. According to the interviews conducted in the study of Goncalves *et al.* (2020), hierarchical culture was found to have a negative relation with organizational agility. Because it only allows incremental changes, not experimentation. Likewise, Alavi *et al.* (2014) supported that flat structure has a positive and significant effect on workforce agility. Considering all these studies flat organizational structure was considered as an important antecedent of organizational agility in construction firms. Accordingly, Hypothesis 2 is proposed. In the model, the flat organizational structure was assessed with one measured variable similar to the study of Alavi *et al.* (2014).

H2. *Flat organizational structure has a significant and positive impact on organizational agility of construction companies.*

3.2.3.2. Change Culture. Organizational culture is the collection of an organization's decisions, actions and values (Crocitto and Youssef, 2003). Management and leadership play important roles to create culture. Organizational culture is a significant enabler because dealing with changes becomes very difficult without change in culture. Hence, organizations need to achieve appropriate cultural change according to changing circumstances (Felipe *et al.*, 2017). To manage the change, which is the main driver of organizational agility (Yusuf

et al., 1999), organizations should accept and embrace change (Hasan *et al.*, 2007). Culture of change is "an environment where people on all organizational levels have positive and fearless attitude to changes, different opinions, new ideas, and technology" (Sherehiy *et al.*, 2007, p. 457). In order to establish a change and innovation culture in the organization, continuous improvement culture should be supported and accepted by employees (Crocitto and Youssef, 2003).

Goncalves *et al.* (2020) stated that companies tend to enhance a culture of change and innovation to accomplish organizational agility. Similarly, Dove (2001) stated that an organizational culture encouraging change provides response-ability. Carvalho *et al.* (2019) proposed that implementation of an operational excellence program through continuous change, and alignment of organizational culture appropriately leads to increased organizational agility. Culture of change is an important enabler to develop agility in an organization. This link also has been specified by several studies (Carvalho *et al.*, 2019; Axelsson and Blomqvist, 2012). Therefore, according to the statements in the existing studies, Hypothesis 3 is proposed. In this study, change culture is measured considering the level of culture of change, continuous improvement and culture of innovation in the organization.

H3. *The change culture has a significant and positive impact on organizational agility of construction companies.*

3.2.3.3. Organizational Learning. Knowledge is significant in today's business world. Learning helps to produce and make use of knowledge (Braunscheidel and Suresh, 2009). Hence, learning at a quick and continuous pace is important to deal with changing circumstances (Goncalves *et al.*, 2020). Organizations learn from experiences through their relations with the external environment, and the relations between their members (Menon and Suresh, 2021; Braunscheidel and Suresh, 2009). Organizational learning provides "a suitable environment to learn new skills and to promote knowledge" (Alavi *et al.*, 2014, p. 6284). It includes obtaining and distributing knowledge throughout the organization (Tsou and Cheng, 2018). As such, a higher level of organizational learning is expected to predict a higher level of organizational agility. Tsou and Cheng (2018) proposed the positive and direct effect of organizational learning on organizational agility and confirmed through their

model with the empirical data collected from IT service firms. Similarly, Govuzela and Mafini (2019) confirmed the relation between organizational learning and organizational agility by providing evidence of positive and significant effect based on the data collected from South African small-medium enterprises. Muduli (2017) concluded that organizational learning and training helps to increase workforce agility, significantly. Hasan *et al.* (2009) emphasized the supportive role of training in agile manufacturing. Further, organizational learning is considered as an enabler of organizational agility in several studies (Carvalho *et al.*, 2020; Conforto *et al.*, 2014; Hassan *et al.*, 2013; Vázquez-Bustelo *et al.*, 2007). Hence, Hypothesis 4 is proposed accordingly. In this study, organizational learning was assessed with the level of gaining knowledge, sharing knowledge and training in the organization.

H4. *Organizational learning has a significant and positive impact on organizational agility of construction companies.*

3.2.3.4. People. The people working in the organizations are critical in creating value for the customers (Gunasekaran *et al.*, 2019). Hence, agile organizations need to advance human resources which have a significant role in developing agility (Charbonnier-voirin, 2011; Gunasekaran and Yusuf, 2002). Because agility can only be accomplished through human capital. Skilled employees play an essential role to achieve agility (Hasan *et al.*, 2009). "Organizations which intend to become agile should include the development of a well trained and motivated workforce, with the right set of skills, expertise and knowledge, as an essential element of their strategies." (Yusuf *et al.*, 1999, p. 39). Multi-skilled and flexible human resources can be reassigned to different works when circumstances require it (Hoyt, 1996). This enhances the flexibility and responsiveness to changes. Additionally, employees need to be empowered, because when employees have authority and power in decision making, the responses are quicker and more appropriate (Gunasekaran *et al.*, 2019; Harraf *et al.*, 2015). Empowerment of employees is one of the most mentioned enablers of organizational agility (Carvalho *et al.*, 2020; Žitkienė and Deksnys, 2018; Harraf *et al.*, 2015; Eshlaghy *et al.*, 2010; Vázquez-Bustelo *et al.*, 2007). GhalichKhani and Hakkak (2016) confirmed that empowerment has a positive effect on organizational agility with the empirical data collected from case studies of a construction engineering company and an industrial company. Similar studies concluded that employee empowerment positively affects organizational agility (Seifollahi and Shirazian, 2021; Nouri and Mousavi, 2020).

Teamwork creates functional working units and helps to empower employees (Gunasekaran *et al.*, 2019). Further, teamwork helps to reduce the separation between management and employees (Crocitto and Youssef, 2003). As a result, decentralized decision-making and control can be achieved. Teams also need to be cross-functional and self-managed (Çardak, 2019). Team working and cross-functional teams are recommended for the improvement of agility in the case study of Vinodh *et al.* (2012). Team working is essential as being an enabler of organizational agility (Ahmadzadeh *et al.*, 2020; Gunasekaran *et al.*, 2019; Aravind Raj *et al.*, 2013). In the study of Muduli (2017), team working was found to create most of the effect in improving workforce agility among other investigated enablers. Eshlaghy *et al.* (2010) tested the relations of several agility enablers such as teamwork and empowerment, and organizational agility. Consequently, they found positive and significant effects. Further, Khatri *et al.* (2018) found significant relations between agile manufacturing and agility enablers such as cross-functional teams, multi skilled and flexible people and empowerment of employees. Consequently, in this construct, multi-skilled and flexible human resources, empowerment of employees, teamwork and cross functional and self-managed team formation are assessed. Hypothesis 5 is developed in accordance with the evidence from the existing studies.

H5. *The people have a significant and positive impact on organizational agility of construction companies.*

3.2.3.5. Technology. Technology has a significant role in developing agility capabilities (Hasan *et al.*, 2007) and technology adoption is a fundamental requirement of agility (Gunasekaran *et al.*, 2019). The use of technology ranges from information technology to Computer Aided Design (CAD) tools (Hasan *et al.*, 2007). Information technology is the use of technology to obtain, present, send, store and manage information (Sud-on *et al.*, 2014). Information technology can enhance agility through utilizing technologies for operations, for developing relations with customers and for enabling collaboration with partners (Sambamurthy *et al.*, 2003). A large portion of the literature investigated the relationship between the use of technology or information technology or information systems and agility (Ridwandono and Subriadi, 2019). Most of them found a positive and significant effect of technology on agility (Khatri *et al.*, 2018; Lu and Ramamurthy, 2011; Zhang and Sharifi, 2007). According to a case study conducted by Aravind Raj *et al.* (2013), technology was

found as the most important enabler of agility. As reported by Shin *et al.* (2015), interview results showed that technology capability enables responsiveness to customer needs. Further, a lot of studies emphasized that information technology is one of the main enablers developing and improving agility (Menon and Suresh, 2021; Eltawy and Gallear, 2017; Sudon *et al.*, 2014; Hassan *et al.*, 2013; Hasan *et al.*, 2009; Sambamurthy *et al.*, 2003). According to interviews in the study of Axelsson and Blomqvist (2012), information technology was found useful and considered as enabling agility in terms of providing efficient processes. Similarly, Gao *et al.* (2020), Panda and Rath (2018), and Mao *et al.* (2015) hypothesized and confirmed with empirical data that information technology capabilities affect organizational agility positively and significantly. In line with these studies, Hypothesis 6 is postulated.

H6. *The technology has a significant and positive impact on organizational agility of construction companies.*

3.2.3.6. External Relations. Today's volatile, dynamic and competitive business environment makes it difficult for organizations to survive individually (Poloie *et al.*, 2012). Hence, organizations should create partnerships with suppliers and customers in order to reduce the devastating effect of competition, gain competitive advantage and create customer value by using fewer resources (Gunasekaran *et al.*, 2019; Poloie *et al.*, 2012). External relationships with companies in the supply chain network indicate the integration of the organization with suppliers, customers, and other partners through coordination and cooperation (Vázquez-Bustelo *et al.*, 2007). Relations can range from distant relations to vertical integration (Hoyt, 1996). Even though the partnership has significant benefits, it may involve some risks as well (Axelsson and Blomqvist, 2012). However, in general, external relationships with companies in the supply chain network are considered agility enablers. Even though external relations and partnership have been discussed mostly in the supply chain agility literature, some studies are examining the effect of partnership on organizational or manufacturing agility. Hoyt (1996) emphasized the enabling role of supply chain relations on agility. Zhang and Sharifi (2007) categorized external relations as a main agility enabler. As reported by Ribeiro and Fernandes (2010), collaboration with suppliers and customers is an important agility enabler according to interviews conducted in construction companies. Further, Axelsson and Blomqvist (2012) also found out the enabling

impact of external collaboration through interviews and literature review. Based on this background, Hypothesis 7 is proposed.

H7. *The external relations have a significant and positive impact on organizational agility of construction companies.*

3.2.3.7. Interrelations between Agility Enablers. In the literature, some studies investigated the interrelationships of organizational agility enablers. Considering these studies several hypotheses are proposed as follows. Sindhwani and Malhotra (2017) proposed that there is a direct impact of organizational structure on flexible workforce. A flat organization structure helps to empower employees by eliminating hierarchy and providing an environment that makes this possible.

H2a. *Flat organizational structure has a significant and positive impact on people of construction companies.*

Sindhwani and Malhotra (2017) investigated the relations between agility enablers and claimed the direct impact of organizational structure on information technology integration. Similarly, Omrani and Zarei (2018) claimed that information and communication technology (ICT) mediates the relationship between organizational structure and organizational agility. Appropriate organizational structure was found to increase the use of technology which leads to organizational agility (Omrani and Zarei, 2018).

H2b. *Flat organizational structure has a significant and positive impact on technology of construction companies.*

Alavi *et al.* (2014) evidenced the positive and significant effect of flat structure on organizational learning. Similarly, Menon and Suresh (2021) justified that organizational structure has a positive and significant effect on organizational learning in the higher education context.

H2c. *Flat organizational structure has a significant and positive impact on organizational learning of construction companies.*

Janićijević (2015) concluded that organizational learning can be achieved in the existence of a culture that supports change. In the study, the effect of change culture on human resources was further emphasized.

H3a. *Change culture has a significant and positive impact on organizational learning of construction companies.*
H3b. *Change culture has a significant and positive impact on people of construction companies.*

Braunscheidel and Suresh (2009) revealed that learning orientation has a positive and significant effect on integral integration which indicates organizational integration through communication and teamwork. Similarly, Alavi *et al.* (2014) hypothesized and confirmed that higher levels of organizational learning lead to higher levels of workforce agility.

H4a. *Organizational learning has a significant and positive impact on people of construction companies.*

Hassan *et al.* (2013) provided an extensive literature review that hypothesizes organizational learning is an antecedent of IT. They further proposed that IT capability acts as a mediator between organizational learning and organizational agility. Likewise, Hasan *et al.* (2009) showed the effect of training and education on the use of information technologies.

H4b. *Organizational learning has a significant and positive impact on technology of construction companies.*

Mao and Quan (2015) inspected the effect of IT on organizational agility. They found that IT has a positive effect on partnering agility. This reveals the importance of IT in terms of sensing and responding to partners.

H6a. *Technology has a significant and positive impact on external relations of construction companies.*

As a result of these hypothesized relationships, the conceptual model is proposed as can be seen in Figure 3.21. In the analysis part, both direct relations and indirect relations are analyzed, and mediation effects are considered as well.

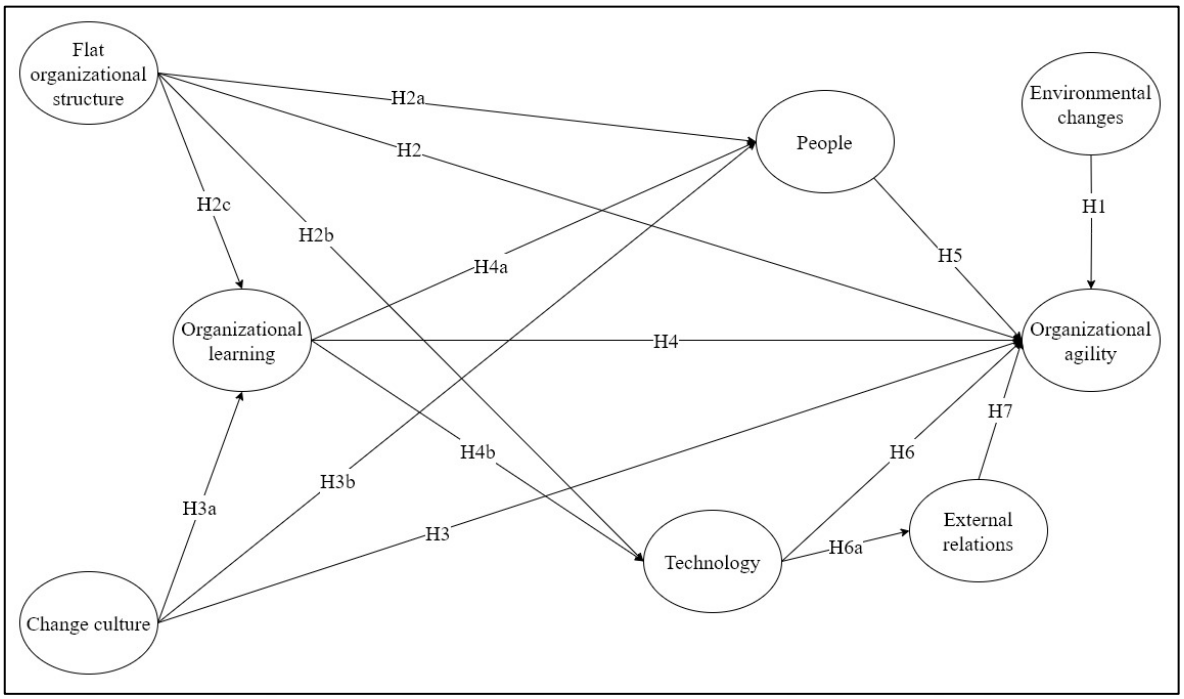

Figure 3.21. Conceptual representation of the SEM model.

3.3. Questionnaire Survey

A questionnaire survey is one of the most common data collection methods. In questionnaires, the same set of questions are asked to every participant in a predesigned order. It helps to reach a large sample size before quantitative analysis (Saunders *et al.*, 2009). In this study, a self-administered and internet-mediated questionnaire survey was conducted as the primary data collection method. It should be noted that the questionnaire items were prepared in English, then translated into Turkish. Firstly, the researcher used direct translation from the source questionnaire (English) to the targeted questionnaire (Turkish). Then, back translation was conducted from the targeted questionnaire to the source questionnaire. The translation was reviewed by four native Turkish speakers who are experienced in translation into English. Accordingly, some changes were made. Questionnaire survey questions can be seen in Appendix A.

The pilot study is critical to test the problems related to questionnaire before survey distribution. In order to clarify and improve the questionnaire, a pilot study was conducted with 14 participants. According to the feedback and opinion of the participants, some of the items were revised and the questionnaire was modified to provide participants a more understandable, easier and clearer questionnaire.

On the first page of the questionnaire, general information about the study was given. Besides, the participant information and consent form was added which includes information about the confidentiality and anonymity of the data, the rights of the participants and the contact information of the researchers. A questionnaire survey was designed to collect data to test hypothesized relations in the proposed conceptual model. It was composed of four parts. In the first part, there were questions regarding environmental changes. The impact of environmental factors on the Turkish construction industry in the present and near future was asked. The questions are designed based on a 5-point Likert scale where 1 is very low impact and 5 is very high impact.

In the second part, organizational agility was defined briefly, and questions regarding the capabilities of organizational agility were asked. The respondents were requested to evaluate that to what extent they agree with given statements about their companies. A 5-point Likert scale was used where 1 is strongly disagree and 5 is strongly agree, similar to several studies (Ezcan *et al.*, 2020; Nouri and Mousavi, 2020; Govuzela and Mafini, 2019; Panda and Rath, 2018; Kanten *et al.*, 2017; Alzoubi *et al.*, 2011; Almahamid *et al.*, 2010). The statements were designed to measure organizational agility including questions regarding sensing, responsiveness, flexibility, and competency.

In the third part, the data related to organizational agility enablers were collected. Similar to the second part, the respondents were asked to assess to what extent they agree with given statements about their companies. A 5-point Likert scale was used where 1 is strongly disagree and 5 is strongly agree. The statements were designed to measure flat organizational structure, change culture, organizational learning, people, technology, and external relations. These parts were primarily presented where the attention of the respondents is high because the validity and reliability of these parts are important for data analysis.

In the last part, general information was asked regarding participants and the companies that they work for. In this part, respondents' roles and years of experience were asked. Besides, some questions were asked regarding the company which are the number of employees, annual turnover, years of operation, location, percentage of international projects, work sector, fields of operation and company type. This part is necessary to determine whether the respondents and their companies are within the scope of this study. Collecting general information is also useful to derive meaningful conclusions and comment on the difference between groups.

The questionnaire survey was examined by the ethics committee of Boğaziçi University. After approval, it was administered to construction industry professionals who work for the construction industry companies in Turkey. Since the questions are related to the perception of employees regarding their companies, the target group was selected as employees who are aware of the general situation of their company such as top-level managers, middle-level managers, engineers, architects, etc. The questionnaire survey was distributed via e-mail to several architecture, engineering and construction (AEC) companies, to members of the Turkish Chamber of Civil Engineers (TCCE) and members of the Turkish Contractors Association (TCA). Besides, it was distributed via professional online platforms such as Linkedin. In order to reach further respondents in the scope of this study, snowball sampling was used where respondents were requested to convey the questionnaire to relevant people. Hence, it is difficult to evaluate the total number of people who receive the questionnaire. However, the questionnaire reached approximately to 2000 respondents. A total of 251 questionnaires were collected out of approximately 2000 sent out, which resulted in a response rate of 12.5%.

3.4. Structural Equation Modeling (SEM)

Structural equation modeling (SEM) is a comprehensive statistical method. "Various theoretical models can be tested in SEM that hypothesize how sets of variables define constructs and how these constructs are related to each other" (Schumacker and Lomax, 2010, p. 2). SEM aims to analyze the theoretical models using hypothesis testing based on sample data. SEM is able to test several models including regression, analysis of variances, path, and factor analysis (Hoyle, 2012; Schumacker and Lomax, 2010). SEM has similarities

with several methods in terms of relying on linear statistical models and being valid under some assumptions. However, it is a more comprehensive and flexible method (Hoyle, 1995, p. 16) since it allows testing more complex and specific hypotheses. SEM can be considered as a generalization and extension of a family of related statistical methods (Hoyle, 2012). Hence, it is also addressed with various names emphasizing its different aspects such as latent variable modeling, covariance structure modeling/analysis, causal modeling/analysis and simultaneous equation modeling (Ullman and Bentler, 2013; Hoyle, 2012; Kline, 2011).

SEM is useful to be employed for both confirmatory and exploratory purposes. SEM models are usually based on existing theories. Besides, they can be used for construct validation. On the other hand, for exploratory purposes, they can be used to develop theory and study potential relations through iterations based on the same data (Raykov and Marcoulides, 2006). In this study, SEM is utilized for its both confirmatory and exploratory aspects. SEM has various advantages. One of the major advantages is being able to take into account, and as a result, remove measurement error (Ullman and Bentler, 2013; Schumacker and Lomax, 2010; Raykov and Marcoulides, 2006). Another critical advantage is its ability to represent and test latent constructs. SEM also can investigate complex relationships and multidimensional phenomena (Ullman and Bentler, 2013; Hair *et al.*, 2009). SEM is a unique combination of interdependence and dependence techniques. It is a sophisticated method that enables testing the relationships between one or more independent and dependent variables, either discrete or continuous (Ullman and Bentler, 2013). Considering these advantages, it became a popular method, and it was employed in this study.

Several software programs are available to conduct SEM analysis. LISREL (LInear Structural RELations) was the first software program developed by Karl Jöreskog. Then, other software programs have been developed. To name some of them, Mplus was developed by Bengt and Linda Muthén, AMOS (Analysis of MOment Structures) by James Arbuckle, EQS (EQuationS) by Peter Bentler, SEPATH (Structural Equations and PATH analysis) which is a module of Statistica by James Steiger, CALIS (Covariance Analysis of LInear Structural equations) which is a module of SAS by Wolfgang Hartmann and some packages in R such as sem by John Fox and lavaan (LAtent VAriable ANalysis) by Yves Rosseel (Loehlin and Beaujean, 2017; Schumacker and Lomax, 2010; Raykov and Marcoulides, 2006). Each program has unique properties and the selection of software depends on the

researcher's needs (Schumacker and Lomax, 2010). In this study, AMOS was utilized due to its ability to solve most of the typical SEM models and its user-friendly interface (Loehlin and Beaujean, 2017).

3.4.1. Definitions of Terms

In SEM, there are two main variable types which are latent and measured variables. Measured variables are also called observed/manifest variables or indicators. They can be measured directly using surveys, tests, etc. on a sample. Latent variables are also named as factors, hypothetical/latent constructs, concepts, or unobserved variables. They are assumed to reflect unobservable phenomena. Latent variables can be measured indirectly with the help of measured variables (Hoyle, 2012). It is commonly recommended to assign more than two indicators per latent variable to specify its multiple aspects with a comprehensive view (Raykov and Marcoulides, 2006). Error terms, which are also called residual or disturbance terms, can be considered latent variables. They represent the error or imperfection in prediction (Ullman and Bentler, 2013; Hoyle, 2012; Raykov and Marcoulides, 2006). Error terms are associated with outcome variables which are measured variables and dependent latent variables. They have error terms typically that indicate unexplained variance by their predictors. This part of unexplained variance may be caused by measurement error or unreliability of score (Kline, 2011).

Variables can also be identified as independent or dependent. Independent variables, also called exogenous, cause, predictor or source variables, are not influenced by other variables. On the other hand, dependent variables, also referred to as endogenous, effect, outcome or downstream variables, are affected by another variable (Loehlin and Beaujean, 2017; Hoyle, 2012; Schumacker and Lomax, 2010). Independent variables have no causal arrows pointing to them, whereas dependent variables have (Hoyle, 2012). Independent variables may have covariances between them, however, dependent variables do not have (Loehlin and Beaujean, 2017).

In the visual presentation of SEM, measured variables are shown as squares or rectangles, latent variables are presented as circles or ellipses, and error terms are demonstrated as circles (Ullman and Bentler, 2013). Relationships between variables are

exhibited with directional arrows. One-way arrows, also called paths, show a direct relationship between variables. They indicate that “a variable at the end of the arrow is explained in the model by the variable at the beginning of the arrow.” (Raykov and Marcoulides, 2006, p. 12). One-way arrows are commonly referred to as causal arrows which assume “a change in the variable at the tail of the arrow will result in a change in the variable at the head of the arrow, all else being equal” (Loehlin and Beaujean, 2017, p. 3). Curved two-way arrows represent covariance between two variables that direction of the relation is not indicated, simply an association (Ullman and Bentler, 2013; Hoyle, 2012; Raykov and Marcoulides, 2006). Covariance is “the measure of how much two random variables vary together.” (Dodge, 2008, p. 126).

A standard SEM model includes two parts which are the measurement model and structural model. The measurement model indicates the relationships between latent constructs and their indicators. The structural model shows the relationships among latent constructs (Ullman and Bentler, 2013; Hoyle, 2012). Furthermore, higher-order constructs may be represented in SEM. In the second-order construct model, first-order latent variables act as indicators of second-order latent variables (Hoyle, 2012). First-order constructs can be considered as dimensions of second-order constructs (Bagozzi and Yi, 2012).

There are two types of relationship between latent variables and measured variables, which are reflective and formative. In reflective measurement models, causality direction is from the latent variables to indicators, which are manifestations of the construct. Indicators are expected to be interchangeable and highly correlated. Hence, they might be changed or deleted without posing any impact on the construct. On the other hand, in formative measurement models, causality is from the indicators to constructs implying that indicators are characteristics of the constructs. Therefore, changes in indicators create changes in the constructs (Jarvis *et al.*, 2003). Some researchers favored the use of reflective constructs over formative constructs due to problems arising in the use of formative constructs (Howell *et al.*, 2007). Formative models lead to issues regarding generalization, cross-validation, and construct validity testing (Bagozzi and Yi, 2012). In this study, the relations were modeled as reflective constructs since the indicators are considered manifestations of the constructs.

3.4.2. Assumptions in SEM

3.4.2.1. Sample Size. SEM is mostly considered as a large sample method. Although there is no consensus among researchers, most of the studies recommend a sample size of 200 for SEM analysis (Bagozzi and Yi, 2012; Kline, 2011). It was indicated that a sample size of 200 or more is "often required for accurate parameter estimates and standard errors" (Loehlin and Beaujean, 2017, p. 61).

The sample size mainly depends on the characteristics of the model and the number of variables (Loehlin and Beaujean, 2017). Wolf *et al.* (2013) conducted Monte Carlo studies to inspect sample size requirements of common SEM models. They revealed that models with a high number of indicators per construct required smaller samples compared to models with few number of indicators. Similarly, models with higher factor loadings required smaller samples, relatively. For example, it was implied that a 3-factor Confirmatory Factor Analysis (CFA) model with 6 indicators having factor loadings of 0.80 necessitates a minimum sample size of 100. According to the Monte Carlo study of Anderson and Gerbing (1984), if there are three or more indicators for each construct, a sample size of 150 is found mostly adequate. Anderson and Gerbing (1984) showed that models with three or more indicators should have at least 100 cases for convergent solutions. These studies suggest that small sample sizes may be acceptable in some conditions (Ullman and Bentler, 2013; Iacobucci, 2010).

Besides that, other sample size requirements were specified in the literature, as well. The ratio of the sample size to free parameters is discussed in several studies. Bentler and Chou (1987) recommended this ratio to be 5:1 for normally distributed data. Bagozzi and Yi (2012) argued that it can be 3:1 or even 2:1 for a satisfactory model. The power calculation is another approach to determine sample size. Based on degrees of freedom values, minimum sample size can be specified. When degrees of freedom is higher than 20, a sample size of 100 to 200 has acceptable power (Loehlin and Beaujean, 2017).

3.4.2.2. Measurement Scales. The measurement scale is another issue in SEM. There are four measurement scales, namely, nominal, ordinal, interval and ratio. The nominal scale assigns different categories for a distinct group of objects. The ordinal scale provides ordered

values, however, equally spaced difference between values cannot be ensured. The interval ratio gives both ordered and equally spaced information. The ratio scale, having the most information, also provides the absolute zero value (Hair *et al.*, 2014).

SEM mainly assumes continuous data. Multivariate analysis methods are in favor of interval and ratio scales (Hair *et al.*, 2014). Categorical variables such as nominal and ordinal scales may be problematic. However, with advances, it is possible to use most of the variable types. To take necessary precautions, variable type and its role in the model are significant (Hoyle, 2012). Dependent variables are measured with the assumption of interval or ratio scale (Hoyle, 2012). Ordinal scales, most commonly Likert scales, can be used as SEM data. However, the Likert scale should have symmetry about the middle category and the distance between categories should be equal (Hair *et al.*, 2014). Bentler and Chou (1987) explains the use of ordinal scale as follows: "Continuous methods can be used with little worry when a variable has four or more categories, but with three or fewer categories one should probably consider the use of alternative procedures". Similarly, Hoyle (2012) emphasizes that if normally distributed ordinal variables have at least 5 categories, they act as continuous variables.

3.4.2.3. Missing Data. Missing data pose significant problems in data analysis. Because, covariance structure should be complete for analysis (Bentler and Chou, 1987). The amount of missing data is important; however, the pattern of the missing data is also critical. Non-random missing data may hinder the generalizability of inferences. For example, refusing to answer a specific question may be associated with attitude (Tabachnick and Fidell, 2007). To handle the missing data, there are different methods which are complete case (listwise deletion), all-available (pairwise deletion), imputation (such as mean substitution) and model-based approaches (Hair *et al.*, 2009).

3.4.2.4. Multivariate Normality. Multivariate normality is "the assumption that each variable and all linear combinations of the variables are normally distributed" (Tabachnick and Fidell, 2007, p. 78). It is a significant assumption in SEM for some estimation methods such as maximum likelihood (Xiong *et al.*, 2015; Ullman and Bentler, 2013; Kline, 2011). Consideration of univariate and multivariate normality together helps to assess normality in a more appropriate manner (Ullman, 2006). The likelihood of satisfying multivariate

normality increases as the variables follow a normal distribution (Tabachnick and Fidell, 2007). Univariate normality of the data can be assessed by examining skewness and kurtosis values (Xiong *et al.,* 2015). Skewness represents the level of symmetrical shape of the distribution of the data about its mean. Kurtosis shows the peakedness of distribution of the data (Xiong *et al.,* 2015). Skewness and kurtosis values between -2 to 2, show univariate normality of the data (George and Mallery, 2003). Skewness and kurtosis values exceeding 2 and 7, respectively, indicate problems of univariate normality (Hoyle, 2012) and kurtosis higher than 10 is quite problematic (Kline, 2011). Other than these statistics, the graphical representation can also be utilized. Frequency histograms and expected normal probability plots are useful for inspecting normality (Tabachnick and Fidell, 2007).

Multivariate normality can be tested with Mardia's coefficient. Mardia's normalized estimate of multivariate kurtosis is represented as the critical ratio (c.r.) value in AMOS. Values up to 5 or 6 are considered as a multivariate normal distribution (Bentler, 2006, p. 106). In the case of nonnormal data, there are some remedies. Outliers can be detected and eliminated. On the other hand, if there is individual skewness, they can be transformed to a scale that may produce normal data. Another method is using bootstrap in which the collected sample is considered as the representative and the repeated sample is used (Loehlin and Beaujean, 2017).

3.4.2.5. Outliers. Outliers indicate extreme values that corrupt statistics. Outliers can be related to a single variable that is univariate or a set of variables that is multivariate (Hair *et al.,* 2009). Univariate outliers can be detected by examining z scores or graphics such as histograms, box plots and normal probability plots (Tabachnick and Fidell, 2007). In cases with z scores higher than 3.29 with $p < 0.001$, the two-tailed test may indicate outliers.

Multivariate outliers can be detected by examining Mahalanobis distance statistics (Byrne, 2010, p. 106). Mahalanobis distance is "the distance of a case from the centroid of the remaining cases where the centroid is the point created at the intersection of the means of all the variables" (Tabachnick and Fidell, 2007, p. 74). A low p value ($p < 0.001$) of this statistic causes the rejection of the null hypothesis which proposes that "the case comes from the same population as the rest" (Kline, 2011, p. 54).

Variables responsible for outliers can be eliminated if also they are highly correlated with other variables and not very significant for the analysis (Tabachnick and Fidell, 2007). Other strategies to reduce the impact of outliers are transformation, changing some scores and deletion of some cases (Tabachnick and Fidell, 2007).

3.4.2.6. Multicollinearity. Collinearity occurs if one of the variables is a "linear combination of other variables" (Dodge, 2008, p. 96). Multicollinearity appears when independent variables are linearly dependent (Hoyle, 2012). Investigating collinearity may help to assess multicollinearity (Hoyle, 2012). Extreme collinearity is the result of distinct variables measuring the same construct. It can be detected from the correlation matrix, with too high correlation values, above 0.90 (Tabachnick and Fidell, 2007). Collinearity can also be detected by running numerous multiple regressions. Tolerance values lower than 0.10 and variance inflation factor (VIF) higher than 10.0 may imply extreme multivariate collinearity (Kline, 2011). Extreme collinearity may take place between latent variables, as well (that will be addressed in the discriminant validity issue). Multicollinearity may cause some troubles that deteriorate the analysis (Tabachnick and Fidell, 2007). Several procedures may be applied to eliminate collinearity. The sum or average value of collinear variables can be used. Besides, principal components may be analyzed and they can be modeled as constructs (Tabachnick and Fidell, 2007).

3.4.3. SEM Implementation Steps

SEM implementation has main steps which are model specification, model identification, model estimation, model evaluation, model modification (Ullman and Bentler, 2013; Hoyle, 2012; Schumacker and Lomax, 2010).

3.4.3.1. Model Specification. In the model specification step, latent and measured variables are determined which to include in the model and the relationships between them are specified. A model is specified based on existing theory. Model specification is important to create a consistent model with the sample data. If there is misspecification, they can be detected and the model can be improved with model modifications (Schumacker and Lomax, 2010).

3.4.3.2. Model Identification. Model identification is required before the estimation of parameters (Ullman and Bentler, 2013). Initially, the status of each parameter should be identified. Free parameters are unknown and estimated based on the data. Fixed parameters are determined by the researcher, commonly either 0 or 1, whereas constrained parameters are unknown, however, constrained to a value (Hoyle, 2012; Schumacker and Lomax, 2010). Identification helps to evaluate unknown information based on known information. The amount of known information can be determined based on the number of measured variables. Generally, for k measured variables, there are k(k+1)/2 known values which are data points representing variances and covariances (Hoyle, 2012). Unknown parameters are values that should be estimated in the model such as variance, covariance, structural coefficients and factor loadings. The relation between known and unknown information specifies whether the model is under-identified, just-identified or over-identified (Hoyle, 2012). In the under-identified model, there are fewer knowns than unknowns. In the just-identified or saturated model, the number of knowns and unknowns are equal. In the over-identified model, the amount of known information is higher than the unknown information. SEM models need to be overidentified for the estimation of parameters. The degrees of freedom which is the difference between the amount of known and unknown information should be non-negative (Ullman and Bentler, 2013; Hoyle, 2012; Schumacker and Lomax, 2010).

Further, in order to evaluate the identifiability of the measurement model part, the number of latent constructs and measured variables can be investigated. When there are more than two latent constructs, there should be more than three measured variables per construct. Besides, measured variables should be loaded on one construct and error terms should not be correlated (Ullman and Bentler, 2013). To assess the identifiability of the structural model part, latent dependent variables can be investigated whether they are recursive or non-recursive. In recursive models, there are no feedback loops where dependent variables predict each other and there is no correlation between error terms. In non-recursive models "either there are feedback loops among dependent variables or there are correlated disturbances among the dependent variables, or both" (Ullman and Bentler, 2013, p. 666). Recursive models can be identified, whereas non-recursive models require some additional conditions to be identified (Ullman and Bentler, 2013).

3.4.3.3. Model Estimation. There are several parameter estimation methods, namely maximum likelihood (ML), generalized least squares (GLS), unweighted least squares (ULS), and asymptotically distribution free (ADF) also called weighted least squares (WLS). ML is one of the most commonly used methods which provides robust results (Iacobucci, 2010). ML and GLS are recommended to be used with medium to large sample sizes (Ullman and Bentler, 2013). They can be utilized under the assumption of multivariate normal distribution of the data (Raykov and Marcoulides, 2006).

If data distribution is non-normal, it may cause some problems in ML estimation. It tends to reject true models, compute poor model fit indices and the results are not trustworthy with more bias (Hoyle, 2012; Kline, 2011). Non-normality may occur due to discrete or categorized scores and the existence of high skewness or kurtosis (Hoyle, 2012). When there are 5 or more categories, the data can be assumed as continuous and normal. On the other hand, there are several options to eliminate issues for continuous but nonnormal data.

One of the solutions is data transformation. Data can be transformed then can be analyzed with default ML estimation. Another option is analyzing with one of the estimation methods and using robust standard errors and corrected model statistics such as Satorra-Bentler statistic (Kline, 2011). Another alternative is using default ML estimation but with nonparametric bootstrapping. In the bootstrap method, a random sample is selected from sample data and replicated as a representative of the population, then used to create bootstrap estimates (Schumacker and Lomax, 2010). Bootstrapping provides less biased and more robust estimates in cases of nonnormal data and sample sizes higher than 200 (Hoyle, 2012; Kline, 2011). However, the sample should be representative and composed of independent observations (Byrne, 2010).

On the other hand, distribution free estimations can also be utilized. ULS and ADF do not assume any distributional properties. ULS provides consistent estimates, however, it is the only scale dependent method that indicates that the results may change according to the scale of measured variables (Schumacker and Lomax, 2010). Hence, in the ULS method, all measured variables should be measured on the same scale. One disadvantage of ULS is generally being less efficient than ML (Dragan and Topolšek, 2014). ADF method generally requires very large sample sizes and fewer variables (Ullman and Bentler, 2013).

3.4.3.4. Model Evaluation. In order to evaluate the SEM model, measurement models should be evaluated, their reliability, validity and fit should be satisfied. Then, the structural model can be constructed, estimated and evaluated.

(i) Reliability is "the degree to which scores in a particular sample are free from random measurement error" (Kline, 2011, p. 69). Reliability evaluates the internal consistency of indicators in each construct (Kline, 2011). For internal consistency, indicators should measure the same construct and should have high intercorrelations (Hair *et al.*, 2009). To evaluate the reliability of a scale, Cronbach's alpha (or coefficient alpha) is the most commonly used index (Ullman and Bentler, 2013; Bagozzi and Yi, 2012; Kline, 2011; Streiner, 2003). If there are high correlations between the items of the construct, alpha becomes higher. Mostly, the alpha values higher than 0.70 are considered satisfactory (Kline, 2011; Hair *et al.*, 2009). However, values higher than 0.95 are not desirable, they may indicate redundancy of some items (Hair *et al.*, 2014; Streiner, 2003).

The alpha value is influenced by the number of items, where a high number of items gives high alpha values (Streiner, 2003). Hence, the inter-item correlations matrix can also be inspected. For reliability, inter-item correlations and item to total correlations are suggested to be more than 0.40 and 0.50, respectively (Hair *et al.*, 2009; Ding and Ng, 2007). Ferketich (1991) recommends correlation values at least 0.30 for items to be sufficiently related, while values higher than 0.70 may indicate redundancy. Another important measure of reliability is composite reliability that considers factor loadings of indicators. Values between 0.70 and 0.90 are regarded as satisfactory (Hair *et al.*, 2014).

(ii) Validity is the degree that indicators represent their corresponding constructs accurately (Hair *et al.*, 2009). Construct validity can be evaluated with content validity, convergent validity and discriminant validity. Content validity, also referred to as face validity, examines whether indicators can represent the concept they are intended to measure (Kline, 2011). To ensure content validity, statistical tests are not available, however, expert judgment, pretests and other methods which are mostly subjective can be used (Hair *et al.*, 2009).

Convergent validity evaluates the extent that indicators measure the same construct, as hypothesized (Kline, 2011). To confirm convergent validity, factor loadings of the indicators should be statistically significant and higher than 0.7 (Kline, 2011). High factor loadings also indicate unidimensionality (Awang, 2012). Indicators with factor loadings lower than 0.7 should be considered for deletion if the convergent validity of the model improves. When loadings are even lower than 0.4, these indicators must be deleted (Hair *et al.*, 2014). Indicators of a particular construct should share a high percentage of variance. The average variance extracted (AVE) is a typical measure to evaluate convergent validity. AVE specifies the extent that a construct explains its indicators' variance. It is "the sum of squared loadings divided by the number of indicators" which presents the communality of a construct (Hair *et al.*, 2014, p. 103). It should be higher than 0.50 suggesting that the construct is able to represent higher than 50% of indicators' variance (Xiong *et al.*, 2015; Hair *et al.*, 2014).

Discriminant validity assesses whether the indicators are distinct which are assumed to measure separate constructs (Kline, 2011). It measures the extent to which a construct is distinct from other constructs. It can be evaluated with inspection of cross-loadings where an indicator should not be loaded higher on other constructs than its corresponding construct. Kline (2011) proposed that correlations between constructs should not be higher than 0.90 to satisfy discriminant validity. Fornell and Larcker (1981) criterion is a common and more conservative approach to test discriminant validity. This criterion implies that a construct should share the highest variance with its indicators than other constructs (Hair *et al.*, 2014). AVE is the average amount of variance of a construct's indicators explained by the construct. While the shared variance is the level of variance of indicators related to other constructs that a construct can explain (Farrell, 2010). Comparison of AVE and shared variance values helps to identify discriminant validity. To ensure discriminant validity, the AVE value of a construct should be higher than squared correlation values with other constructs (in other words, the square root of AVE should be higher than correlations with other constructs) (Xiong *et al.*, 2015; Farrell, 2010). Another approach to test discriminant validity was suggested by Rönkkö and Cho (2020) recently. They proposed a guideline to determine the level of discriminant validity by calculating confidence intervals based on correlation values between constructs. This approach provides a continuum for the decision of discriminant validity rather than yes/no approach. At a 95% confidence interval, when the upper limit of

the correlation value is lower than 0.8, there is no problem. When it is between 0.8 and 0.9, there is a marginal problem, it can be reported, and its causes can be discussed. Values higher than 0.9 indicate a moderate problem, higher values should be recognized and examples from the literature should be given. However, values higher than 1 show a severe problem. They mostly indicate discriminant validity problems.

If construct validity cannot be ensured, the model needs to be revised. Because it may cause weaker results and wrong interpretation of relations between constructs. Farrell (2010) suggests the use of exploratory factor analysis, confirmatory factor analysis, an inspection of modification indices, and/or combining constructs to address discriminant validity problems. Exploratory factor analysis (EFA) is beneficial to examine cross-loaded items. EFA is sometimes used as a preliminary approach to explore the latent constructs and predict the relations between the constructs and their latent variables (Dragan and Topolšek, 2014). It is also useful when searching underlying constructs among a set of measured variables (Dragan and Topolšek, 2014). Confirmatory factor analysis (CFA) is a fundamental element of SEM (Ullman and Bentler, 2013). It is useful to explain the degree to which a hypothesized model based on prior research is in line with collected data (Dragan and Topolšek, 2014). CFA is mainly conducted to confirm the validity of latent constructs that helps to validate the measurement model before testing the structural model part of SEM. Confirmatory factor analysis (CFA) can also be used to investigate correlated error terms and modification indices. Moreover, in the case of high correlations between constructs (higher than 0.90), they can be combined if it is theoretically meaningful (Farrell, 2010).

(iii) Model fit indicates the level that the model can explain the sample data. Fit indices create a continuum that the degree of fit can be measured. They are generally inspected within two groups: absolute fit indices and incremental (relative or comparative) fit indices (Hoyle, 2012; Hu and Bentler, 1998). Fit indices may also be grouped as goodness-of-fit which the model improves as the values increase and badness-of-fit indices where lower values indicate better fit (Hoyle, 2012). Another way of classifying fit indices is as descriptive and alternative fit indices. The latter group is developed based on non centrality parameter which represents the level of the model's unfit to the data (Raykov and Marcoulides, 2006).

Absolute fit indices measure the extent of model fit in terms of reproducing the sample data (Hu and Bentler, 1998). They show the percentage of observed covariance that the model is able to represent (Kline, 2011). Reproduced (or predicted) covariance matrix and observed sample covariance matrix are compared. If the difference between these matrices is large, this shows the proposed model is not consistent with the sample data which may be caused by the model or the data (Raykov and Marcoulides, 2006). Chi-square ($\chi 2$) is the fundamental and traditional statistic that measures the model's fit to the data. The $\chi 2$ statistic is sensitive to sample size and number of parameters, hence, evaluating model fit with $\chi 2$ is problematic for large sample sizes and complex models (Iacobucci, 2010). $\chi 2$/df ratio is not a formal fit index; however, it is used as a measure to eliminate some shortcomings of $\chi 2$. The values lower than 5 are satisfactory (Awang, 2012) and lower than 2 indicates a good fit for the $\chi 2$/df ratio (Ullman, 2007).

Goodness-of-fit index (GFI) is developed to measure the extent of explained variance. GFI was further adjusted to correct model overfit when parameters are added, introducing the Adjusted Goodness-of-fit index (AGFI). GFI and AGFI values increase with an improved model fit and both are influenced by sample size (Hoyle, 2012). On the other hand, the root mean square error of approximation (RMSEA) estimates lack of fit as a function of non centrality parameter (Hoyle, 2012; Ullman, 2007). Compared to other indices, RMSEA is less influenced by the sample size (Raykov and Marcoulides, 2006). The values lower than 0.05 are considered as close fit, values between 0.05 and 0.08 are fair fit, between 0.08 and 0.1 are mediocre fit, while values above 0.1 indicate poor fit (Hu and Bentler, 1998; Browne and Cudeck, 1992). Standardized root mean square residual (SRMR) represents the average value of all standardized residuals (Byrne, 2010). The values lower than 0.05 are considered as good fit, values between 0.05 and 0.08 are acceptable fit, between 0.08 and 0.1 are reasonable fit, while values above 0.1 indicate poor fit (Hoyle, 2012; Schumacker and Lomax, 2010; Vandenberg and Lance, 2000; Hu and Bentler, 1998).

Incremental fit indices measure the relative improvement in comparison of the hypothesized (proposed) model with the independence (null or baseline) model (Hu and Bentler, 1998). The independence model is the most restricted (also can be seen as the worst) model which predicts the extreme case of no relationships between variables (Hoyle, 2012; Raykov and Marcoulides, 2006). Normed fit index (NFI) compares $\chi 2$ values of models.

However, NFI may underestimate the model fit for small sample sizes, since it is prone to produce higher values for larger sample sizes. Hence, in order to solve this issue, the non-normed fit index (NNFI; also named as Tucker–Lewis index, TLI) might be used, since it considers degrees of freedom, as well (Raykov and Marcoulides, 2006). However, NNFI is problematic in terms of variability (Hu and Bentler, 1998). Accordingly, the problem of high variability might be handled by using the incremental fit index (IFI). Additionally, the comparative fit index (CFI) compares the level of non centrality in proposed and independence models (Raykov and Marcoulides, 2006). CFI performs well in terms of power and robustness and it provides a good estimate in small samples (Iacobucci, 2010; Ullman, 2007; Hu and Bentler, 1998). NFI and CFI indices are normed and have a range from 0 to 1, whereas NNFI (or TLI) and IFI may have values outside of this range. 0 represents a poor fit while 1 indicates a perfect fit. Incremental fit indices above 0.90 are considered as acceptable and above 0.95 as good fit (Hu and Bentler, 1998). $\chi 2$, SRMR, RMSEA, IFI, CFI and TLI are the most cited and recommended fit indices in the past studies (Iacobucci, 2010; Ullman, 2007; Hu and Bentler, 1998; Bagozzi and Yi, 1988). Therefore, these fit indices were examined to evaluate model fit. The recommended values for several fit indices are presented in Table 3.5.

Table 3.5. Recommended values for fit indices.

Index	Recommended value		Related references
$\chi 2$/df	< 2	good fit	(Dragan and Topolšek, 2014; Awang, 2012; Hoyle, 2012; Ullman, 2007)
	< 5	acceptable fit	
RMSEA	< 0.05	close fit	(Loehlin and Beaujean, 2017; Awang, 2012; Hu and Bentler, 1998; Browne and Cudeck, 1992)
	0.05 – 0.08	fair fit	
	0.08 – 0.10	mediocre fit	
	> 0.10	poor fit	
SRMR	< 0.05	good fit	(Hoyle, 2012; Schumacker and Lomax, 2010; Vandenberg and Lance, 2000; Hu and Bentler, 1998)
	0.05 – 0.08	acceptable fit	
	0.08 – 0.10	reasonable fit	
GFI AGFI NFI IFI TLI CFI	> 0.95	good fit	(Awang, 2012; Hoyle, 2012; Schumacker and Lomax, 2010; Vandenberg and Lance, 2000; Hu and Bentler, 1998)
	> 0.90	acceptable fit	

3.4.3.5. Model Modification. SEM is considered as a confirmatory approach, however, data may be inconsistent with the model, often times. Kline (2011) explains that alternative models can be tested based on satisfactory theoretical and empirical evidence, in this situation. Another approach is the model generation by modifying the initial model. The modified model should have a theoretical base and be consistent with data.

Model modification is necessary to increase the model fit and improve the model. "A model is considered inadequate, requiring modification, if it either (1) has an adequate fit to the data with excessive parameters (i.e., overparameterization) or (2) does not have an adequate fit to the data (i.e., underparameterization)" (Hu and Bentler (1998) as cited by Hoyle (2012, p. 232)). The Wald theory and Lagrange Multiplier (LM) theory can be used to modify the model. In the first case, model fit is adequate and model simplification is needed, hence, a backward search is necessary. In this regard, the Wald theory produces a multivariate test to decrease the number of free parameters by establishing constraints (Hoyle, 2012; Bentler and Chou, 1987). In the second case, model fit is not satisfactory and model improvement is needed, hence, forward search is required (Hoyle, 2012). "The Lagrange Multiplier theory yields comparable information for releasing a set of constraints on parameters or adding free parameters" (Bentler and Chou, 1987, p. 108). Both the Wald and LM tests need to be implemented stepwise so that one change is done in each step (Hoyle, 2012).

3.4.4. Mediation Analysis

Mediators explain the relationship between an independent variable (X) and a dependent variable (Y). There is a causal relationship between independent, mediator and dependent variables as can be seen in Figure 3.22. Path a indicates the direct effect of the independent variable on the mediator, path b shows the direct effect of the mediator on the dependent variable. The mediated indirect effect can be found by multiplying a and b. Path c presents the direct impact of the independent variable on the dependent variable. The total effect is represented as c' and calculated as the sum of indirect and direct effects (Zhao *et al.*, 2010) which is c' = (a x b) + c.

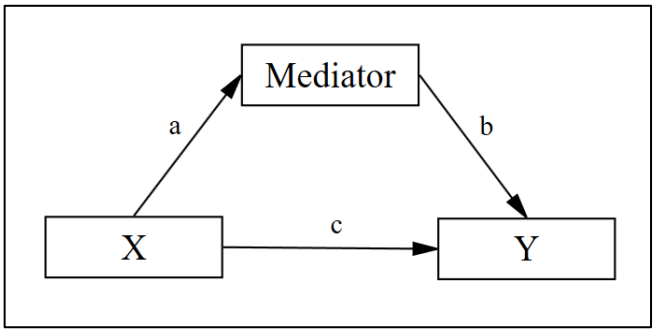

Figure 3.22. Simple mediation model (adapted from Baron and Kenny (1986)).

Mediation can be simple, serial and parallel. Simple mediation includes one mediator between the relation of independent and dependent variables. If there are multiple mediations, when the mediators have causal relations, it is called serial mediation. In case of no relation between mediators, it is called as parallel mediation. In the case of multiple mediators, specific indirect effects can be calculated and compared. Total indirect effect equals the sum of all specific indirect effects (Demming *et al.*, 2017).

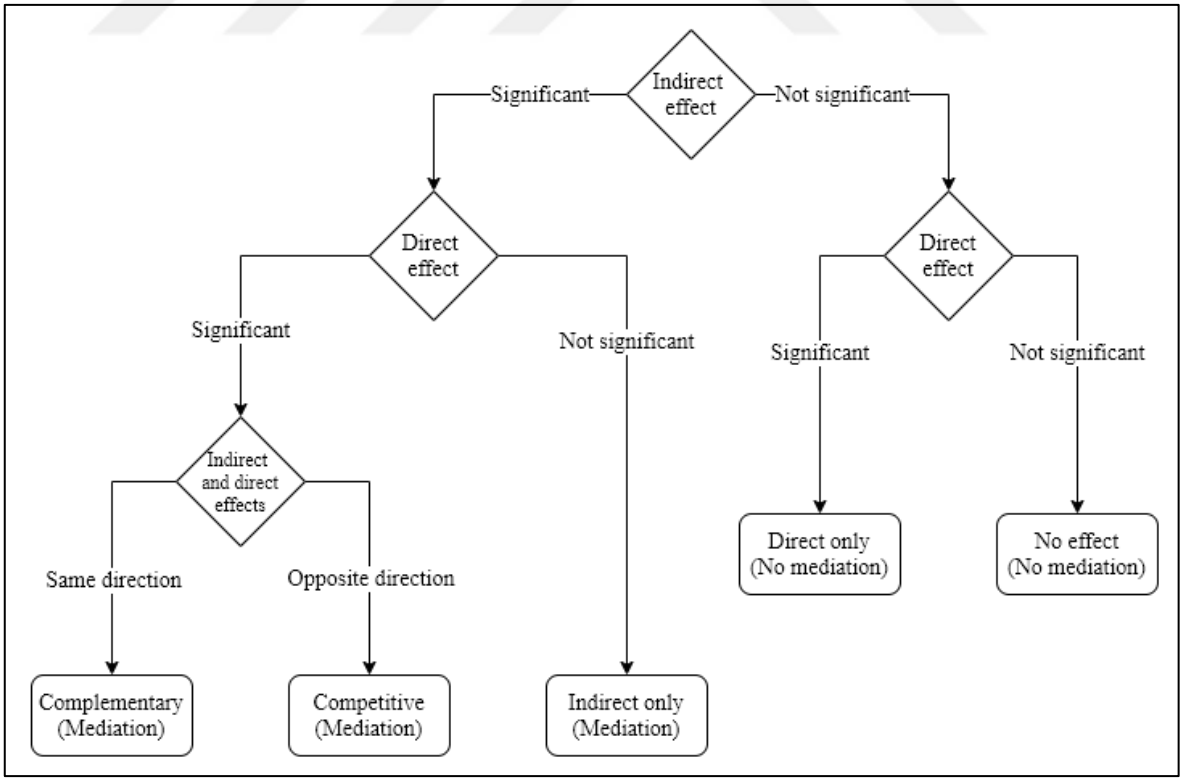

Figure 3.23. Mediation types (adapted from Zhao *et al.* (2010)).

Mediation analysis was carried out traditionally with Baron and Kenny method and Sobel test. On the other hand, the bootstrap approach provides more robust and powerful results. Bootstrap analysis resamples the existing data and provides confidence intervals for indirect, direct and total effects. Bias-corrected bootstrap accounts for the bias due to the nonnormal distribution of the data. It is the standard procedure for mediation analysis (Demming *et al.*, 2017). In order to classify mediation types, Zhao *et al.* (2010) proposed a decision tree based on the significance of indirect and direct effects of relationships. This classification can be seen in Figure 3.23.

4. ANALYSIS RESULTS AND DISCUSSION

The questionnaire survey was distributed in May 2021. Within one month, 251 questionnaires were returned out of approximately 2000 sent out, which resulted in a response rate of 12.5%. Before data analysis, collected data were inspected and screened. Then, SEM analysis was conducted. Accordingly, analysis results and research findings were reported. Hypotheses were discussed and several implications from the study were revealed.

4.1. Data Examination

Data screening is critical before SEM analysis; it ensures the suitability of the data for the analysis (Xiong *et al.*, 2015). Data should be inspected, since there may be errors in the data due to incorrect answers, invalid responses and incorrect transcription of data. Then, descriptive statistics should be inspected. The number of valid cases, variability, central tendency, missing data, normality, outliers and correlations between variables should be examined before data analysis (Hoyle, 2012).

Following data collection, the data were screened carefully before analysis. To assess the ratings for the components developed in the SEM, a prior investigation was conducted as part of data screening. The sample was examined to detect any inaccuracy. Errors in data were checked whether respondents provide incorrect or irrational responses, whether there were typing errors, etc. However, since the online questionnaire was designed to accept only valid responses, the data was not problematic. Some extreme cases were noticed and recorded to be evaluated in the following steps. Missing data were also examined. There was not any missing data in the questionnaire survey. Because the questions related to measured variables were designed as required questions that remind respondents to answer missing ones before submission.

Statistical Package for Social Science (SPSS) Version 25 was used in data management. Collected data (N=251) was inspected using the descriptive statistics including median, mean, standard deviation, skewness and kurtosis values, which is

presented in Appendix B Table B.1 based on the descending values of mean scores. Median values were within the range of 3 to 5, whereas mean values were between 2.91 and 4.64. Further, it was observed that skewness values range between -2.385 and 0.048, where kurtosis values were between -1.314 and 7.935.

Univariate normality was considered by examining descriptive statistics. Skewness and kurtosis values within the range of -2 to 2, mainly indicate the univariate normal distribution of the data (George and Mallery, 2003). However, some variables were found to be outside of this range. Env1 had a kurtosis value of 2.796 and Env2 had skewness and kurtosis values of -2.385 and 7.935, respectively. In order to further evaluate the normality of variables, univariate outliers were checked. The z scores were inspected and most of the values were found to be within the range of -3.29 and 3.29 except Env1 and Env2. In 4 cases, z scores were out of range. Additionally, frequency histograms, box plots and normal Q-Q plots of all variables were drawn and inspected. Hence, distributions and outliers were visualized. Nearly all variables were found to follow the normal distribution. Q-Q plots signified that especially Env1 and Env2 were not normally distributed. These inspections showed that Env1 and Env2 have univariate normality problems. According to z score inspection, 4 outlier cases were deleted (N=247). As a result, univariate normality improved. Kurtosis value was reported as 1.081 for Env1; and skewness and kurtosis values were reported as -1.460 and 1.207 for Env2, respectively.

Being one of the assumptions in some estimation methods of SEM, multivariate normality was also evaluated. It was evaluated with Mardia's normalized estimate of multivariate kurtosis (c.r. value in AMOS). It was reported as 27.7 which is a very high value considering a threshold of 6. To investigate multivariate nonnormality, multivariate outliers were detected by using Mahalonobis distance statistics. Significance values of Mahalonobis distances were calculated and cases that have significance values lower than 0.001 were recorded. They were possible outliers. Hence, 9 cases were eliminated (N=238) to satisfy multivariate normality. However, after this procedure, Mardia's statistic was reported as 16.5 which is still higher than 6. Supporting this statistic, the chi-square Q-Q plot of Mahalanobis distance was examined and the graph showed that many Mahalanobis distance values do not follow chi-square distribution. Hence, the data was considered as multivariate nonnormal. The sample size of 238 was used as the final dataset which descriptive statistics that can be

seen in the Appendix B Table B.2. Further, a bootstrap procedure was followed in order to deal with nonnormal data.

In order to detect extreme collinearity, high correlation values were checked in the correlation matrix which can be seen in Appendix C. Pearson correlation values were reported as lower than 0.90. However, some of them were higher than 0.80. The correlation between Orgc2 and Orgc3 was 0.859; Tech1 and Tech2 was 0.849; Orgl1 and Orgl2 was 0.829. In case of any problems, these variables were recorded and to be observed in the following steps. To inspect multicollinearity, linear regression analysis was run and tolerance and VIF values were inspected. The maximum VIF value was reported as 6.95 which is lower than 10. Even though the values were lower than 10, in some studies maximum tolerance value of 5 is recommended. Hence, the variables that have tolerance values higher than 5 were recorded in case of problems in the following steps of the analysis (Flex2, Orgc2, Orgc3, Orgl2, Tech2). For now, extreme multicollinearity is not observed.

Other important SEM requirements were also considered. The initial sample size was 251 and after data screening, it decreased to 238. The sample size is satisfactory, considering the specified threshold of 200 cases in most of the previous studies. Further, the ratio of the sample size to the number of parameters is higher than 5 (238/41=5.8) as recommended. The measurement scale was a 5-point Likert scale with five categories ranging from 1: “I strongly agree” to 5: “I strongly disagree”. Hence, the collected data has an ordinal measurement scale. Since the number of categories is 5, data can be considered as continuous.

4.2. General Information regarding Respondents and Their Companies

Demographic information shows the general profile of respondents and responding companies. They were examined in terms of representing the Turkish construction industry. Because, proving the sample comes from the population is critical to ensure that relevant information is collected and results are generalizable (Bentler and Chou, 1987). Further, the independence of observations is significant to prevent the underestimation of standard errors (Hoyle, 2012). The scope of this study intends to present the data of companies operating in the construction industry in Turkey.

Respondents mainly consisted of managers, engineers and architects. As can be seen in Table 4.1, they were grouped under different categories. The top-level management category represents roles such as the board of directors, chief executive officer, general manager, managing director, project manager and 16% of respondents were in this group. The middle-level management category includes job titles such as department head, branch manager, department chief and 30% of respondents were in this group. The majority of the respondents were engineers with 41% of the total. Architects and designers were represented with 11% of total responses. There were also a few responses from consultants and accountants (2%). Considering the respondents' years of experience in the construction industry, Table 4.1 shows that the majority of the respondents were experienced up to 15 years. The respondents had an experience of 9 years on average in the construction industry.

Table 4.1. General information regarding respondents.

Demographics	Categories	Frequency (n)	Percentage (%)
Job description	Top-level management	38	16%
	Middle-level management	71	30%
	Engineer	98	41%
	Architect/designer	26	11%
	Other	5	2%
Experience in the construction industry	0 – 5 years	99	42%
	6 – 10 years	55	23%
	11 – 15 years	48	20%
	16 – 20 years	16	7%
	> 20 years	20	8%

The distribution of respondent's companies was inspected in terms of company type, company size, company age, fields of operation, location of the company's head office, work sector, and percentage of international projects. The distribution of companies was shown in Table 4.2. Majority of the companies were general contractors (58%). An important portion of them were engineering companies (33%) and consultant companies (25%). The remaining ones were from architecture companies (16%), clients (16%), subcontractors (15%) and investors (15%). Other companies were building audit companies and suppliers (3%). Since most companies had more than one role, the values do not add up to 100%.

Respondents' companies were grouped as micro, small, medium and large-sized companies. According to Regulation on the Definition Qualification and Classification of Small and Medium-Sized Enterprises (2018) in Turkey, micro-sized companies are defined

as companies in which the number of employees are less than 10 and net sales revenue or the financial balance sheet is less than 3 million Turkish Lira (TL). The number of employees and range of net sales revenue or the financial balance sheet is 10-49 and 3-25 million TL for small-sized companies; 50-250 and 25-125 million TL for medium-sized companies; higher than 250 and higher than 125 million TL for large-sized companies, respectively. The companies were categorized based on the number of employees, and it was found that the sample is mostly composed of large-sized companies (35%) whereas small (25%) and medium (25%) sized companies have a significant share. According to TURKSTAT (2021) data, the contribution of Turkish construction industry companies on total turnover according to company size is as follows in 2019: 16% of total turnover is from micro-sized, 26% small-sized, 22% medium-sized and 36% large-sized companies. It can be seen that the distribution of companies follows a similar trend in this sample. Hence, it can be stated that the data collected represents the construction industry companies in Turkey appropriately.

Respondents' companies were experienced in the construction industry, years of operation was 27.6 on average, ranging between 1 and 152 years. The majority of the companies were operating in the construction industry for up to 40 years. Most of the companies were medium-aged (47%) and old (42%). It was further implied that the majority of the companies were operating in fields of commercial projects (55%), residential building projects (53%), industrial projects (48%) and infrastructure projects (42%). Some companies were also operating in different areas such as transportation, coastal structures, restoration and strengthening projects, however, their share was small, and they were categorized as other. Since companies mostly operate in several types of projects, the values do not add up to 100%. Regarding the location of the company's head offices, İstanbul had the largest share (62%), followed by Ankara (23%) and İzmir (3%). Besides, there were several responses from different cities of Turkey (11%) such as Bursa, Kocaeli, Çanakkale, Konya, Antalya, Mersin, Manisa, Samsun, Rize, Trabzon and Niğde. Considering that most of the companies' head offices are located in metropolitan cities of Turkey, this sample can be regarded as representative.

The work sector of the companies that projects are carried out was also inspected. The companies were mostly from the private sector (45%). Besides, a significant portion of companies was carrying out projects in both public and private sectors (34%). Further, the

presence of international projects in the company was evaluated. The majority of the companies (66%) specified that they have international projects. Considering the percentage share of international projects, 39% of companies reported that they have international projects consisting of up to 50 % of the company's total business volume. 27% of companies indicated that international projects constitute at least 50% of their total business volume. On the other hand, a significant portion of companies (32%) were not operating in international projects.

Table 4.2. General information regarding respondents' companies.

Demographics	Categories	Frequency	Percentage
Company type	Client/owner	39	16%
	Investor	36	15%
	General Contractor	137	58%
	Subcontractor	36	15%
	Engineering company	78	33%
	Architecture company	39	16%
	Consultant company	59	25%
	Other	7	3%
Company size (number of employees)	Micro (< 10)	35	15%
	Small (10 – 49)	59	25%
	Medium (50 – 250)	60	25%
	Large (> 250)	84	35%
Company age (years of experience)	Young (1 – 5 years)	26	11%
	Middle-aged (6 – 25 years)	112	47%
	Old (> 25 years)	100	42%
The location of the company's head office	İstanbul	148	62%
	Ankara	55	23%
	İzmir	8	3%
	Other	27	11%
Work sector	Public sector	46	19%
	Private sector	108	45%
	Both	82	34%
Field(s) of operation	Commercial projects	130	55%
	Residential building projects	126	53%
	Infrastructure projects	101	42%
	Industrial projects	114	48%
	Other	12	5%
The percentage of international projects in the company	None	76	32%
	0 – 50%	93	39%
	50 – 100%	65	27%

4.3. Structural Equation Model Analysis

SPSS AMOS Version 25 was used in SEM analysis. According to the developed conceptual model, the SEM model was constructed, and iterative analysis steps were carried out. First of all, measurement models were evaluated, then initial and final models were analyzed.

4.3.1. Measurement Models

In order to evaluate the SEM model, firstly, measurement models should be validated (Awang, 2012). Reliability analysis was conducted for each construct. Cronbach alpha values were ranging between 0.878 and 0.962 as can be seen in Table 4.3. All constructs indicated a good level of reliability since they were much higher than the cut-off value of 0.70. Composite reliability values were also inspected and all values were higher than 0.70.

Table 4.3. Cronbach alpha, composite reliability, and AVE values of latent constructs.

Latent constructs	Cronbach alpha value	Composite reliability	AVE
Organizational agility	0.962	0.963	0.619
Change culture	0.927	0.929	0.813
Organizational learning	0.905	0.913	0.778
People	0.878	0.879	0.645
Technology	0.909	0.917	0.786
External relations	0.884	0.889	0.728

Content validity was ensured through extensive literature review, expert opinions with the interviews and pretest of the questionnaire with pilot study. Convergent validity was evaluated with inspection of AVE values. As can be seen in Table 4.3, that all AVE values were higher than 0.50. Further, factor loadings of indicators in the measurement models were inspected. Indicators of organizational agility (Bootstrap estimation mean values; Sens1, 0.721; Sens2, 0.758; Sens3, 0.79; Sens4, 0.797; Resp1, 0.81; Resp2, 0.84; Resp3, 0.745; Resp4, 0.762; Resp5, 0.745; Flex1, 0.726; Flex2, 0.849; Flex3, 0.84; Flex4, 0.841; Comp1, 0.798; Comp2, 0.799; Comp3, 0.735), change culture (Orgc1, 0.846; Orgc2, 0.949; Orgc3, 0.906), organizational learning (Orgl1, 0.862; Orgl2, 0.911; Orgl3, 0.836), people (Peop1,

0.796; Peop2, 0.85; Peop3, 0.769; Peop4, 0.742), technology (Tech1, 0.884; Tech2, 0.941; Tech3, 0.813), external relations (Ext1, 0.866; Ext2, 0.899; Ext3, 0.788) constructs were statistically significant and higher than 0.7. This also confirms convergent validity.

Table 4.4. 95% upper limit of the correlation of latent constructs.

Correlation of latent constructs			Correlation	Standard error	95% Lower limit	95% Upper limit
Change culture	↔	Organizational learning	0.875	0.021	0.834	0.916
Change culture	↔	People	0.839	0.026	0.788	0.890
Change culture	↔	Technology	0.785	0.030	0.726	0.844
Change culture	↔	External relations	0.747	0.035	0.678	0.816
Organizational learning	↔	People	0.904	0.020	0.865	0.943
Organizational learning	↔	Technology	0.765	0.032	0.702	0.828
Organizational learning	↔	External relations	0.798	0.031	0.737	0.859
People	↔	Technology	0.762	0.034	0.695	0.829
People	↔	External relations	0.767	0.035	0.698	0.836
Technology	↔	External relations	0.776	0.032	0.713	0.839
Change culture	↔	Organizational agility	0.814	0.025	0.765	0.863
Organizational learning	↔	Organizational agility	0.784	0.029	0.727	0.841
People	↔	Organizational agility	0.760	0.033	0.695	0.825
Technology	↔	Organizational agility	0.732	0.034	0.665	0.799
External relations	↔	Organizational agility	0.752	0.033	0.687	0.817

Discriminant validity was inspected with the help of guidelines provided by Rönkkö and Cho (2020). As can be seen in Table 4.4, the upper limit of correlation values at 95% confidence interval are mostly lower than 0.90 that indicates a marginal problem. However, the upper limit of the correlation between change culture and organizational learning presents a moderate problem. Similarly, organizational learning and people had a value higher than 0.90. All constructs were found to justify discriminant validity. Any of them did not exceed 1 which indicates a severe problem. Only, change culture, organizational learning and people constructs may need further revision or explanation which will be addressed later. In order to evaluate the model, model fit indices were reported as well, they can be seen in Table 4.5. Organizational agility and people constructs had some fit indices which were not in the acceptable range.

Model fit was evaluated and reported as can be seen in Table 4.5. Organizational agility and people constructs had fit indices out of recommended thresholds. Small problems related to discriminant validity and model fit showed that the model needs a minor revision.

Before constructing a structural model, measurement models should be modified and improved. When the organizational agility measurement model is examined, the highest modification indices (MI) were inspected with one by one addition of covariances. Covariances between error terms of Sens1 and Sens2 (MI: 48), Flex1 and Flex2 (MI: 42), Comp2 and Comp3 (MI: 30), Flex3 and Flex4 (MI: 26), Comp1 and Comp2 (MI: 27), Sens2 and Sens3 (MI: 21) were suggested by AMOS. These modifications were reasonable both theoretically and conceptually. Because the corresponding indicators of these error terms were placed successively in the questionnaire. Hence, the error terms are considered to be related. It also seems reasonable that a specific relationship exists between the indicators of the same subconstruct of organizational agility. After these revisions, model fit improved and values were within the acceptable ranges as can be seen in Table 4.5. When the people measurement model is examined, Peop3 had the lowest loading (0.748). Modification indices suggested drawing covariance between error terms of Peop3 and Peop4 (MI: 19). Suggested covariances between error terms may indicate redundancy of items. Redundant items can be deleted or covariances between error terms may be specified in the model. However, when recommended covariance is added, factor loading of Peop3 dropped to 0.696 which is lower than 0.7. Hence, Peop3 was eliminated rather than adding covariance. Peop3 and Peop4 were both measuring teamwork; hence, redundancy is reasonable.

Measurement models were evaluated after revision; the reliability, validity and model fit values improved. Reliability of people construct was satisfactory with Cronbach alpha value of 0.853 and composite reliability value of 0.859, while the values for organizational agility did not change. Convergent validity was also satisfactory with AVE values of 0.672 and 0.613 for people and organizational agility constructs, respectively. Besides, all factor loadings were significant and higher than 0.7 which supports convergent validity. Discriminant validity was improved. The 95% upper limit of correlation value between organizational learning and people was decreased from 0.943 to 0.927. Further, all correlation values became lower than 0.90 which indicates better discriminant validity. Model fit values were improved, and the values were within the range of acceptable thresholds as can be seen in Table 4.5.

Table 4.5. Model fit indices for the measurement models.

Construct	Organizational agility	Organizational agility (revised)	Change culture	Organizational learning	People	People (revised)	Technology	External relations
$\chi 2/df$	4.200	2.344	1.376	1.549	11.800	0.811	2.864	1.331
RMSEA	0.116	0.075	0.040	0.048	0.214	0.000	0.089	0.037
SRMR	0.047	0.035	0.005	0.010	0.041	0.008	0.009	0.013
IFI	0.898	0.960	0.999	0.999	0.958	1.001	0.996	0.999
TLI	0.882	0.950	0.998	0.997	0.871	1.002	0.989	0.998
CFI	0.897	0.959	0.999	0.999	0.957	1.000	0.996	0.999

4.3.2. Initial SEM Model

After revision of the measurement models, the structural model was constructed based on the conceptual model and relevant hypotheses were proposed as can be seen in Figure 4.1. Further, covariances between independent measured variables (items related to environmental changes) were presented, as well. This is theoretically and conceptually reasonable. As stated by Loehlin and Beaujean (2017), independent variables may have covariances between them. Because, independent variables may have an impact on each other, and environmental change items may be related. Further, they were placed successively in the questionnaire which may explain the covariance of error terms.

Model specification: There are 40 measured variables and 51 latent variables, 6 of which are factors, 40 of which are error terms and 5 of which are disturbance terms. Change culture construct, measured variables which are Flat, Env1, Env2, Env3, Env4, Env5, Env6, Env7, Env8, error terms and disturbance terms are exogenous variables. Other measured variables and latent constructs are endogenous variables.

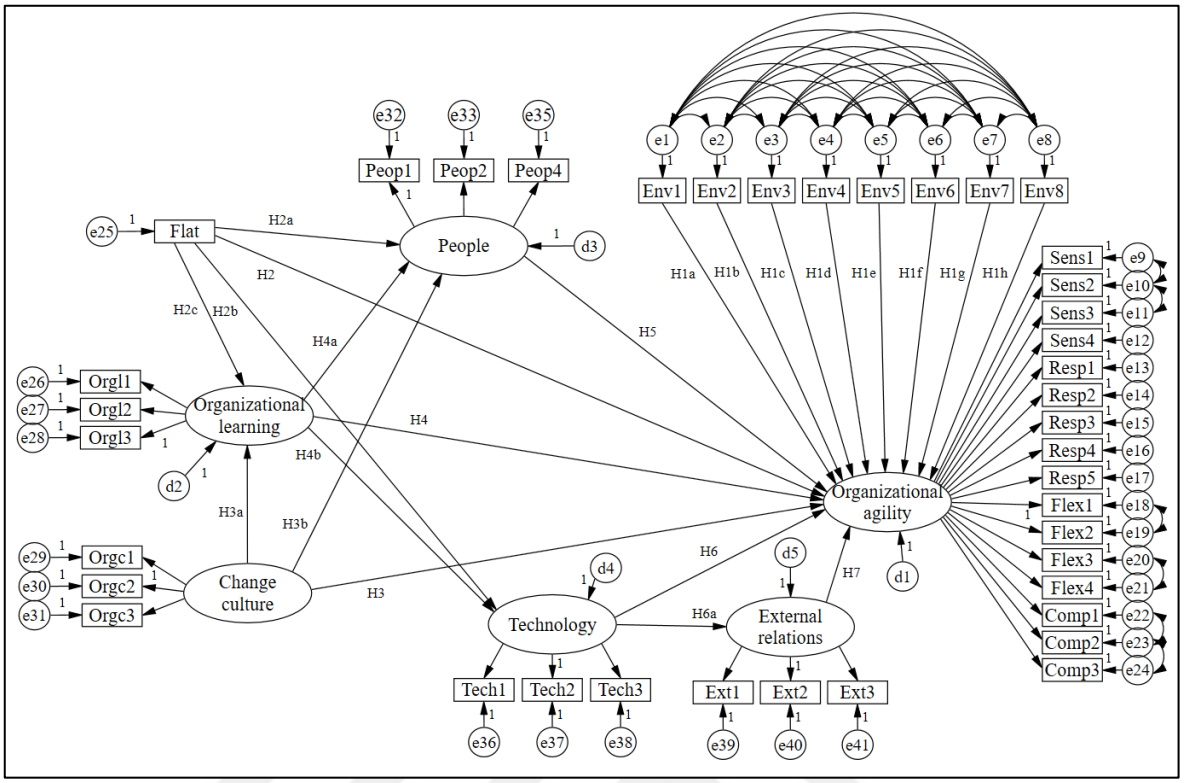

Figure 4.1. The initial SEM model.

Model identification: In the model, there are 40 measured variables that create 40(40+1)/2 = 820 data points. On the other hand, there are 98 factor loadings (or regression weights) 51 of which are fixed and 47 of them are free. It should be noted from Figure 4.1 that some regression weights (regression paths between error terms and variables, and one of the regression paths between latent variables and their indicators) are fixed to 1 as recommended by Ullman and Bentler (2013) and Byrne (2010). Hence, they are not counted as estimated parameters. There are 45 variances including 40 error variances and 5 disturbance variances. Besides, there are 34 covariances. In total, there are 126 parameters to be estimated. Degrees of freedom becomes 820-126=694 which is also confirmed by AMOS output. Since the known information is much higher than the unknown information, the model is over-identified. Besides, there are at least three indicators for each construct. On the other hand, the model can be considered as recursive, since there are no feedback loops between dependent variables. Consequently, all these implications indicate that the model is identified.

Model estimation: Distributional characteristics of data, sample size and quality of estimations were considered to select the estimation method. Data was found to show characteristics of multivariate nonnormality. Hence, ML and GLS methods could not be used. ADF was not applicable since it requires very large sample sizes such as thousands of cases. ULS could be utilized because all measured variables were on a 5-point Likert scale, conveniently. However, it was found to be less efficient than ML (Hoyle, 2012). Hence, alternative methods were also considered. Data transformation was also an option; however, interpretation of results could be problematic. Robust ML estimation was another powerful method, but it was not available in AMOS software. Being another mostly used alternative, bootstrapping could be utilized. AMOS provides many features for bootstrapping method (Hoyle, 2012). Besides, bootstrapping provides robust estimations compared to ML for non-normal data. As a result, bootstrapping is selected as the estimation method in the scope of this study. In the analysis, bootstrap was used with 5,000 bootstrap samples at a 95% bias-corrected confidence interval. Factor loadings of the items for their corresponding constructs can be seen in the Appendix D Table D.1. Further, regression weights for the hypothesized relationships were presented in Appendix D Table D.2. Also, mediation effects were summarized in Table 4.8. The meaning of these values in terms of conceptual perspective will be detailed in the discussion section.

Model evaluation: The reliability and validity of the measurement models did not change. When model fit of the overall model is inspected, the values are within the recommended thresholds as can be seen in Table 4.6. However, the model can be improved further. Because, some paths were found insignificant. Hence, in order to finalize the model, rejected paths are removed from the model which will be presented in the final model.

4.3.3. Final SEM Model

Final model was constructed in order to propose a more specified model representing Turkish construction industry according to collected data. In the final model, measurement models were not revised, only paths were assessed. First of all, environmental change factors were not found to have a significant effect on organizational agility. Their standardized regression weights were very close to 0, ranging between -0.045 to 0.063. Their confidence

intervals include 0, where lower bound values were negative and upper bound values were positive. Hence, they were removed from the model.

When the relation between flat organizational structure and organizational agility was inspected, the relation was negative and significant. The flat structure also had a significant relation with people construct. On the other hand, its relationship with technology and organizational learning constructs was not significant and standardized regression weights were close to 0. Further, when mediation effects of possible paths from flat organizational structure to organizational agility were inspected, they were nearly 0 (ranging between -0.002 and 0.015) and not significant. Therefore, the paths from flat structure to technology; and flat structure to organizational learning were removed.

Change culture had a positive, strong and significant relationship with organizational agility and organizational learning. However, it did not show a significant relation with people construct, and the standardized regression weight was near 0 which is 0.004. When mediation effects were inspected, the total indirect effect was found significant. However, when specific indirect effects were reviewed, people construct was not mediating the relation between change culture and organizational agility. Hence, the path between change culture and people was removed. Organizational learning and its proposed paths were inspected as well.

Organizational learning was found to have an insignificant effect on organizational agility. The standardized regression weight was close to 0 which is -0.026, and the lower and upper bounds were -0.564 and 0.444, respectively, which provides a large confidence interval. Hence, this path was eliminated. On the other hand, organizational learning had positive, strong and significant path estimates with people and technology constructs. Mediation effects showed that organizational learning had indirect relations with organizational agility rather than direct relation.

The effect of people on organizational agility was found as insignificant. However, the strength of the relationship was not weak, which is 0.199 and p value was not very high compared to other paths which is 0.193. Besides, people construct had some antecedents which may further create mediation effects. Hence, it was decided to keep the path in the

final model. Technology was also found to have an insignificant effect on organizational agility. However, it had some antecedents which may help to establish mediation effects. Similarly, it was therefore kept in the model. External relations construct was inspected to have a significant effect on organizational agility. It also mediated some of the relationships. So, it was kept in the model, as well.

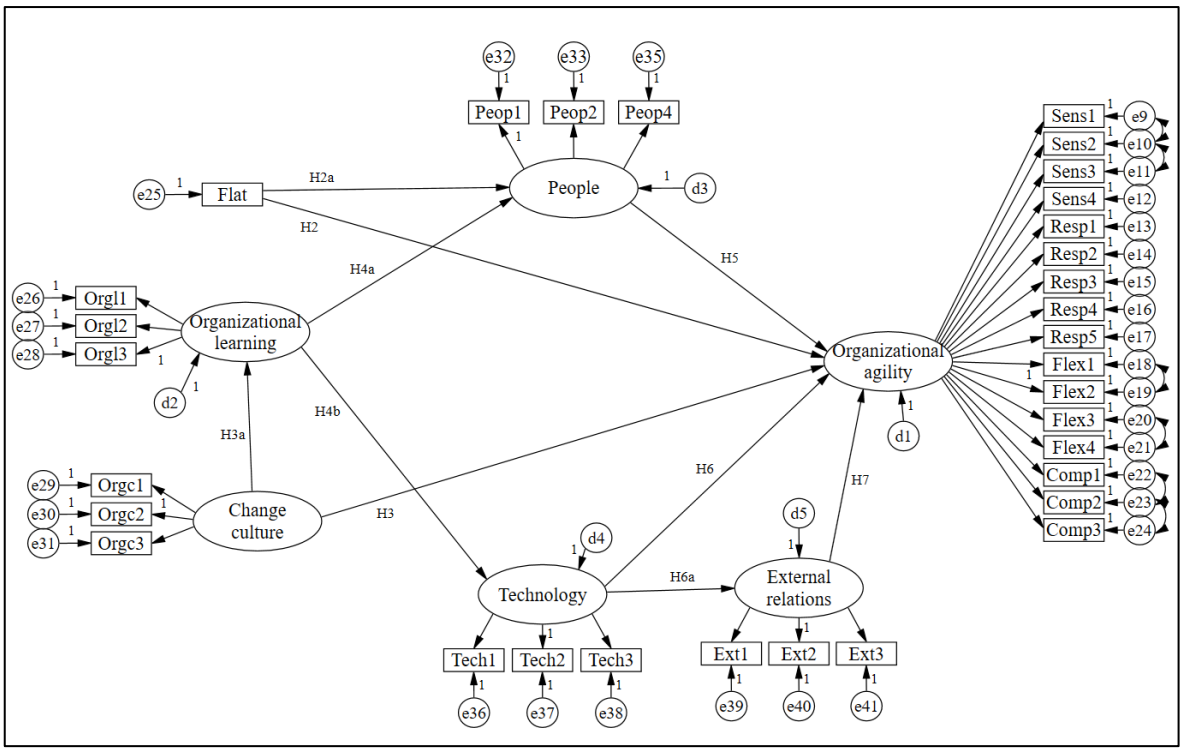

Figure 4.2. The final SEM model.

According to these revisions, the final model was constructed as can be seen in Figure 4.2. To assess the final model, SEM steps were implemented. In the model specification step, variables were reviewed. There are 32 measured variables and 43 latent variables, 6 of which are factors, 32 of which are error terms and 5 of which are disturbance terms. Model identification was verified, considering that the degrees of freedom was 449 indicating an over-identified model. In the model estimation step, bootstrap was used with 5,000 bootstrap samples at a 95% bias-corrected confidence interval. Factor loadings of the items for their corresponding constructs, standardized regression weights for the paths can be seen in Appendix D Table D.3 and Table D.4, respectively. Besides, the mediation effects are summarized in Table 4.8. The meaning of these values in terms of conceptual perspective will be detailed in the discussion section. In the model evaluation step, the reliability and

validity of the measurement models did not change. Since they were the same as the initial model. On the other hand, most of the model fit indices were further improved as can be seen from Table 4.6.

Table 4.6. Model fit indices for the initial and final models.

Model / Index	Initial model	Final model
$\chi 2/df$	1.826	2.031
RMSEA	0.059	0.066
SRMR	0.079	0.084
IFI	0.924	0.935
TLI	0.914	0.928
CFI	0.923	0.934

4.4. Perception of Organizational Agility

In this section, a discussion of research findings from descriptive statistics is presented. First of all, the average score of questionnaire items can be discussed. Descriptive statistics were given in the Appendix B Table B.2. However, in order to visualize average scores, they were presented in Figure 4.3. When environmental change factors are inspected, economic changes (Env2) had the highest impact on construction companies, followed by political changes (Env1). Besides, legal changes (Env6) had also a high impact on companies. Rivalry among existing companies (Env8) was also high. These findings support the background research that implies environmental changes in the Turkish construction industry create a need for organizational agility. When organizational agility indicators were inspected, the average scores of all measured variables were higher than 3. Monitoring internal and external data (Sens1) had the highest score which shows that construction companies care about this issue. Adapting to changing conditions (Flex3) and taking advantage of opportunities (Resp4) were also high, relatively. Considering these variables, even though the values are not very high, it is seen that Turkish construction companies are not in a very bad situation.

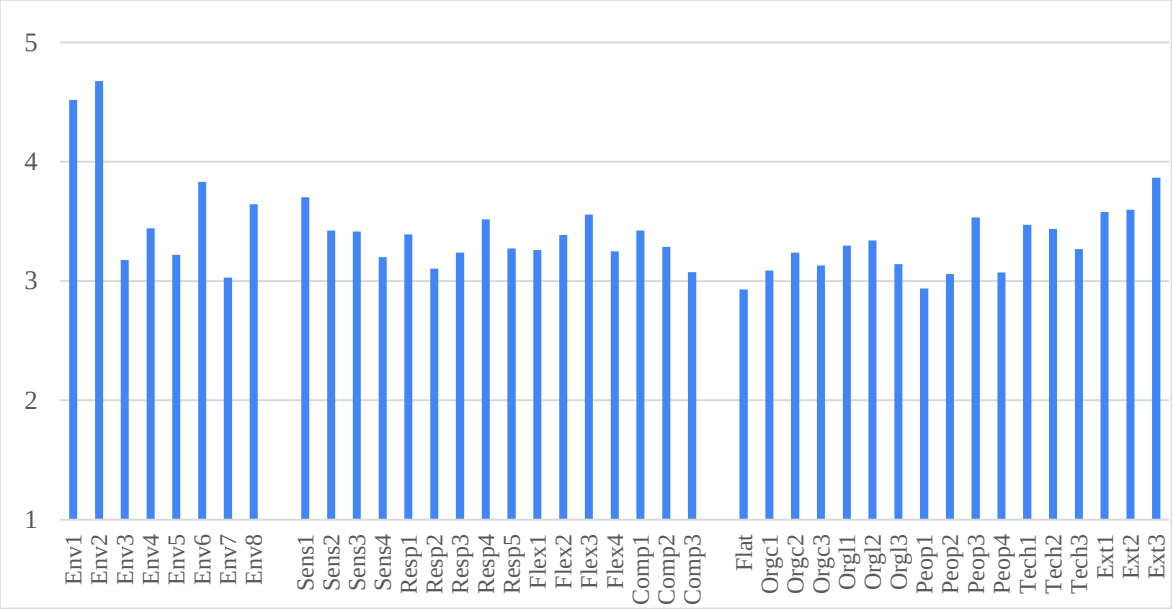

Figure 4.3. Average scores of the measured variables.

Organizational agility enablers show that Turkish construction companies are doing better in developing external relations with customers, suppliers and other firms (Ext1, Ext2, Ext3), developing teamwork (Peop3) and using adequate technology (Tech1, Tech2), relatively. On the other hand, flat organizational structure (Flat) had the lowest score. It may be implied that Turkish construction companies mostly have a hierarchical structure.

The questionnaire item “what is the level of organizational agility of your company according to your perception?” had an average score of 3.25 based on a 5-point Likert scale from very low to very high. This may be an indication that the respondents perceive their companies’ organizational agility level as average. To further investigate the perception of organizational agility according to the profile of respondents and their companies, considering the role of the respondent, organization size, organization age, work sector and percentage of international projects in the company, the data is visualized and inspected with the help of radar charts as can be seen in Appendix E.

Environmental change factors mostly followed the same trend among different groups. This is reasonable since all companies exist in the same environment. They were nearly the same for different groups of respondents representing different job titles. When organization size is considered, for most of the factors, large companies had slightly lower scores which

may indicate a relatively low impact of environmental changes on large companies. Micro and small companies rated rivalry among competitors (Env8) relatively higher. They may be affected by competition higher, compared to larger companies. Organization age does not seem to affect the scores very much, since young, medium-aged and large companies follow a similar trend. On the other hand, the work sector that companies are operating in seems to show some differences. Public sector companies mostly rated the impact of environmental changes lower, especially rivalry among competitors. This may suggest that the environment is more favorable for companies operating in the public sector, relatively. When the percentage of international projects is considered, companies operating in only local projects seem to experience a relatively higher threat of new entrants.

Organizational agility items were also inspected to reveal the differences between groups. When the respondent role is considered, top management level respondents rated the items higher and architects rated lower, relatively. This may show the influence of perception among different job titles. Organization size groups follow a similar trend, however, small-sized companies seem to have higher ratings, relatively. Organization age groups show that young companies tend to have higher ratings, for most of the items. Work sector groups represent that public sector companies rate organizational agility items lower, compared to other companies. When the percentage of international projects is considered, companies that have international projects with a percentage higher than 50% of their total projects tend to rate organizational agility items higher.

Organizational agility enablers were evaluated considering different groups, as well. Similar to organizational agility, top management level respondents tend to perceive organizational agility enablers higher. When organization size is considered, as the organization size becomes smaller, the organizational structure becomes less hierarchical. Smaller organizations also seem to have a culture that embraces change, relatively. Organizational learning and people items such as flexible human resources, empowerment of employees and teamwork were rated lower in large organizations, relatively. Awareness and use of technology were nearly the same for all groups, while large companies had slightly lower scores in external relations. When organization age is considered, young companies rated organizational agility enablers higher. On the other hand, public sector

companies rated enablers lower. A large difference was not observed according to the percentage of international projects in the company.

4.5. Discussion of Hypotheses

This study resulted in several research findings and implications for the Turkish construction industry. Proposed hypotheses are evaluated based on statistical analysis results. In the initial model, some hypotheses could not be supported. This is reasonable, because, in the development of hypotheses, the referred studies were mostly from other industries due to a lack of studies in the construction industry context. Further, there were relatively few empirical studies investigating the interrelations between organizational agility enablers, as well. As a result, in the final model, paths that do not have significant direct or indirect effects were removed in order to get clear parameters, similar to the study of Eshlaghy *et al.* (2010). It also helps to finalize the model specific to the Turkish construction industry. Test results of hypotheses are summarized in Table 4.7. Standardized bootstrap estimates are given along with p values. Strength of the relations is interpreted by adopting the guideline provided by Dancey and Reidy (2011). 0 means no relationship and as the values are closer to (+ or -) 1, the relationship becomes stronger. Coefficients between 0.1 and 0.3 indicate a weak association, 0.3 to 0.6 represent a moderate relation, and values higher than 0.6 show a strong association according to Dancey and Reidy (2011). Besides, the summary of mediation effects can be seen in Table 4.8. Unstandardized bootstrap estimates are given along with p values. Mediation types are specified according to classification of Zhao *et al.* (2010).

Table 4.7. Summary of hypothesis testing.

Hypothesized Relationship				Initial model		Final model		Strength of relationship	Significance (at 0.05 level)	Hypothesis result
				Estimate	p value	Estimate	p value			
H1a	Env1	→	Organizational agility	0.027	0.473	Removed		No relation	Not significant	Not supported
H1b	Env2	→	Organizational agility	0.035	0.415	Removed		No relation	Not significant	Not supported
H1c	Env3	→	Organizational agility	0.033	0.456	Removed		No relation	Not significant	Not supported
H1d	Env4	→	Organizational agility	0.064	0.159	Removed		No relation	Not significant	Not supported
H1e	Env5	→	Organizational agility	-0.046	0.323	Removed		No relation	Not significant	Not supported
H1f	Env6	→	Organizational agility	0.052	0.240	Removed		No relation	Not significant	Not supported
H1g	Env7	→	Organizational agility	0.036	0.514	Removed		No relation	Not significant	Not supported
H1h	Env8	→	Organizational agility	-0.013	0.810	Removed		No relation	Not significant	Not supported
H2	Flat	→	Organizational agility	-0.105	0.024	-0.109	0.015	Weak	Significant	Not supported
H2a	Flat	→	People	0.117	0.020	0.129	0.007	Weak	Significant	Supported
H2b	Flat	→	Technology	-0.023	0.660	Removed		No relation	Not significant	Not supported
H2c	Flat	→	Organizational learning	0.045	0.336	Removed		No relation	Not significant	Not supported
H3	Change culture	→	Organizational agility	0.464	0.003	0.441	0.000	Moderate	Significant	Supported
H3a	Change culture	→	Organizational learning	0.895	0.000	0.899	0.000	Strong	Significant	Supported
H3b	Change culture	→	People	0.021	0.822	Removed		No relation	Not significant	Not supported
H4	Organizational learning	→	Organizational agility	-0.029	0.882	Removed		No relation	Not significant	Not supported
H4a	Organizational learning	→	People	0.856	0.001	0.880	0.000	Strong	Significant	Supported
H4b	Organizational learning	→	Technology	0.824	0.001	0.825	0.000	Strong	Significant	Supported
H5	People	→	Organizational agility	0.197	0.193	0.215	0.032	Weak	Significant	Supported
H6	Technology	→	Organizational agility	0.112	0.221	0.074	0.417	No relation	Not significant	Not supported
H6a	Technology	→	External relations	0.803	0.000	0.804	0.000	Strong	Significant	Supported
H7	External relations	→	Organizational agility	0.213	0.011	0.233	0.004	Weak	Significant	Supported

Table 4.8. Summary of mediation effects.

	Initial model		Final model		Mediation type
	Unstd bootstrap estimate	p value	Unstd bootstrap estimate	p value	
Flat structure ⟶ People ⟶ Organizational agility	0.015	0.135	0.019	0.017	Competitive (mediation)
Flat structure ⟶ Technology ⟶ Organizational agility	-0.002	0.463	Removed		
Flat structure ⟶ Technology ⟶ External relations ⟶ Organizational agility	-0.003	0.519	Removed		
Flat structure ⟶ Organizational learning ⟶ Organizational agility	-0.001	0.674	Removed		
Flat structure ⟶ Organizational learning ⟶ People ⟶ Organizational agility	0.005	0.202	Removed		
Flat structure ⟶ Organizational learning ⟶ Technology ⟶ Organizational agility	0.003	0.253	Removed		
Flat structure ⟶ Organizational learning ⟶ Technology ⟶ External relations ⟶ Organizational agility	0.004	0.196	Removed		
Change culture ⟶ Organizational learning ⟶ Organizational agility	-0.020	0.883	Removed		
Change culture ⟶ Organizational learning ⟶ People ⟶ Organizational agility	0.117	0.163	0.134	0.027	Complementary (mediation)
Change culture ⟶ Organizational learning ⟶ Technology ⟶ Organizational agility	0.064	0.214	0.043	0.409	Direct-only (no mediation)
Change culture ⟶ Organizational learning ⟶ Technology ⟶ External relations ⟶ Organizational agility	0.098	0.010	0.110	0.003	Complementary (mediation)
Change culture ⟶ People ⟶ Organizational agility	0.003	0.663	Removed		
Organizational learning ⟶ People ⟶ Organizational agility	0.138	0.166	0.154	0.029	Indirect-only (mediation)
Organizational learning ⟶ Technology ⟶ Organizational agility	0.075	0.218	0.050	0.410	No-effect (no mediation)
Organizational learning ⟶ Technology ⟶ External relations ⟶ Organizational agility	0.115	0.010	0.126	0.004	Indirect-only (mediation)
Technology ⟶ External relations ⟶ Organizational agility	0.150	0.010	0.167	0.003	Indirect-only (mediation)

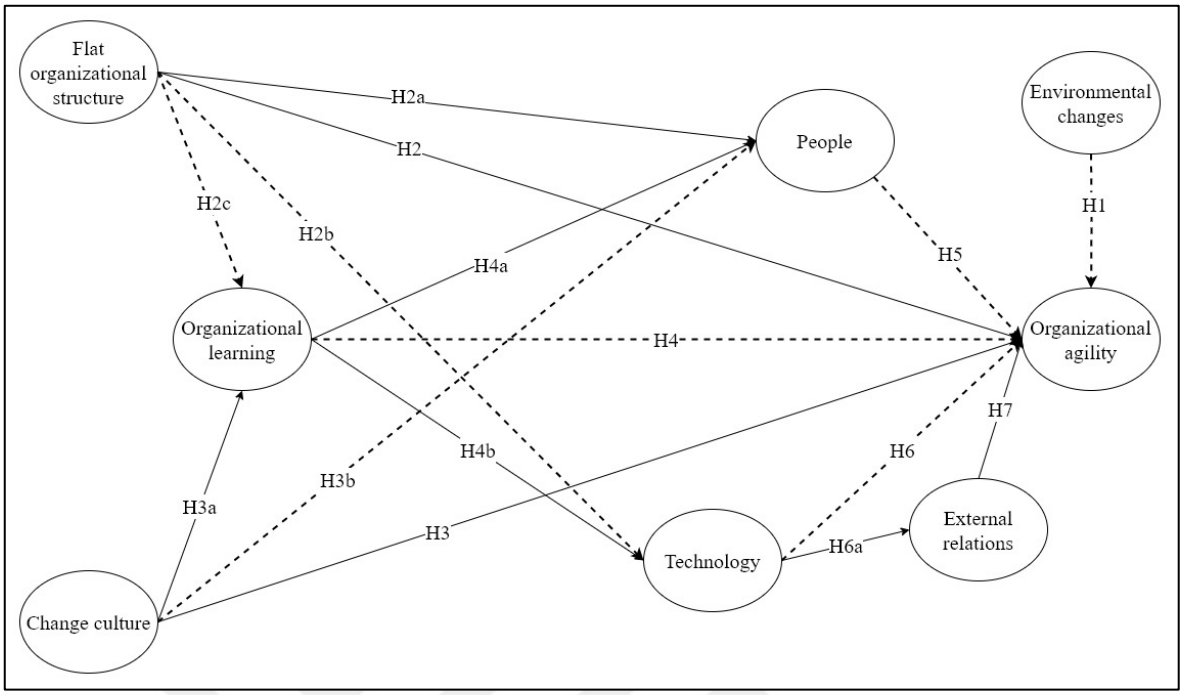

Figure 4.4. Conceptual representation of the initial SEM model.

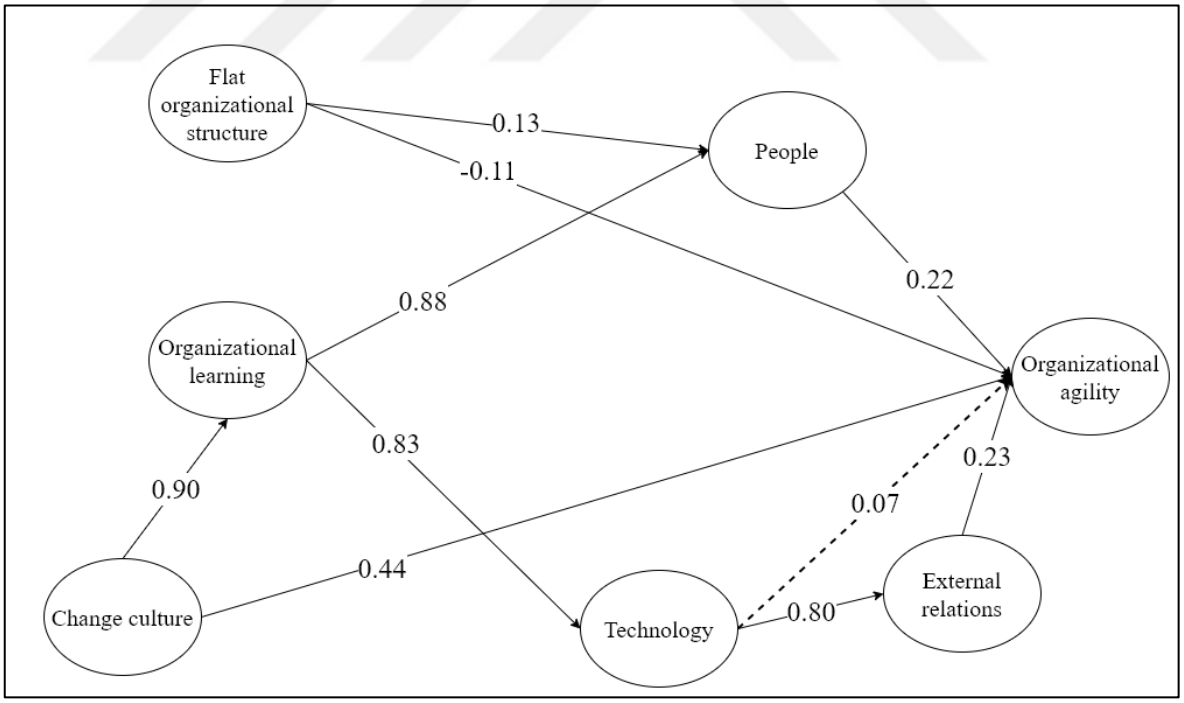

Figure 4.5. Conceptual representation of the final SEM model.

Conceptual representations of the initial and final SEM models are also visualized in Figure 4.4 and Figure 4.5, respectively. Dashed lines indicate insignificant effect. The results are discussed in the following sections.

4.5.1. Environmental Changes

The first hypothesis was related to the effect of environmental changes on organizational agility. Most of the definitions included change as an important driver of agility and some studies proposed a direct and positive impact of change on organizational agility (Walter, 2021; Vázquez-Bustelo *et al.*, 2007). However, SEM results showed that the effect of environmental changes on organizational agility is insignificant and very close to 0 indicating no relationship. In the scope of this study, it can be implied that environmental change factors do not directly impact organizational agility of Turkish construction companies, considering other elements in the model as well. Hoyt (1996) hypothesized several enablers and tested their effects on agility in dynamic-hostile environments comparing successful and unsuccessful companies. However, any significant difference could not be found based on the empirical data collected from manufacturing companies. Since there are not many studies providing empirical evidence to reveal the direct effect of environmental changes, it is hard to prove or refute this finding from existing literature.

The environmental conditions are more or less the same for companies operating in the same industry and the same country, even though the impact could change. It could be the reason for the insignificant direct effect. In the case of examining the same model for companies from different countries, the model could give different results, since the environmental change factors would be different. On the other hand, results could be different if a longitudinal study was conducted. The evaluation of agility along with environmental changes through a time period would create more meaningful results, rather than a cross-sectional observation. Besides that, environmental factors such as uncertainty, diversity and hostility were modeled as moderators in several studies (Panda and Rath, 2018; Liu *et al.*, 2016; Mao *et al.*, 2015; Tallon and Pinsonneault, 2011; Hoyt, 1996). Environmental change factors could result in different findings as moderators in the model.

4.5.2. Flat Organizational Structure

The second hypothesis proposed the positive and direct effect of flat organizational structure on organizational agility. According to analysis results, the hypothesis could not be supported. Because the relation was negative and significant (standardized regression weight: -0.109; p: 0.015 < 0.05) proposing a weak negative effect of flat structure on organizational agility. This finding can be explained that the absence of hierarchy may hinder organizational agility to a small extent. Because, flatter organizational structure may pose some problems due to mis-implementation such as unbalanced power dynamics and development of hidden hierarchies (Crosby, 2020). Some studies are revealing a similar relation. In the study of Felipe *et al.* (2017), hierarchy culture was hypothesized as being negatively related to organizational agility. However, they could not find support from the data they analyzed. They found a positive and significant effect of hierarchy culture on organizational agility. They revealed that stability and control may enable organizational agility to a certain degree. Similarly, Aghina *et al.* (2015) emphasized that agility requires both stable and dynamic structure where it should be based on a stable foundation. Additionally, Ahmadi *et al.* (2012) investigated the correlation between organizational agility and organizational structure which is modeled with complexity, formalization and centralization subconstructs. They found that correlation coefficients were negative, the correlation value between complexity and organizational agility was insignificant, while formalization and centralization constructs had significant correlations with organizational agility.

Further, the impact of flat organizational structure on people, technology and organizational learning was inspected. Only, the relation between flat organizational structure and people was found significant. Results showed that flat structure has a weak positive effect on people (standardized regression weight: 0.129; p: 0.007 < 0.05). In flatter organizations, employees can share their ideas more comfortably without strict hierarchies, and empowerment increases (Crosby, 2020). This result is consistent with findings in the study of Sindhwani and Malhotra (2017). Additionally, mediation effects were inspected to find out any indirect effect between flat organizational structure and organizational agility. In the final model, a positive mediatory role of people construct was found (unstandardized bootstrap estimate: 0.019; p: 0.017 < 0.05). This mediation is classified as competitive

mediation where the direction of direct and indirect effects is opposite. In this type of mediation, according to Zhao *et al.* (2010), there may be omitted mediators. Even though technology and organizational learning were proposed as mediators, they did not show a significant indirect effect. However, in future research, other mediators could be traced, as well. This is an interesting finding that flat structure may have a small negative impact on organizational agility directly due to some problems and mis-implementation. However, when flexible human resources are employed, employees are empowered, cross-functional and self-managed teams are developed, the flat structure can have a positive effect on organizational agility indirectly through the mediatory role of human resources.

4.5.3. Change Culture

The third hypothesis postulated the significant and positive effect of change culture on organizational agility. Analysis results supported this hypothesis by providing a moderate positive relation which is significant (standardized regression weight: 0.441; p: 0.000 < 0.05). Having a culture that embraces change, supports continuous improvement and innovation is critical for developing organizational agility. Without a culture of change in the organization, improvements stay as point improvements and implemented agile methods become only a toolbox that prevents the company from benefitting full potential of agility. The literature supports the notion that agile organizations should have an organizational culture that facilitates change (Goncalves *et al.*, 2020; Carvalho *et al.*, 2019; Holbeche, 2018).

When other relations were inspected, change culture was found to have a strong, positive and significant effect on organizational learning (standardized regression weight: 0.899; p: 0.000 < 0.05). In an organization where a change culture is established, employees also embrace change as an important concept. As a result, they provide new ideas and seek new solutions, which leads to learning (Janićijević, 2015). For example, Cai *et al.* (2017) validated that innovation culture strengthens the relation between knowledge management and agility. On the other hand, the relationship between change culture and people constructs was close to 0 and insignificant (standardized regression weight: 0.021; p: 0.822 > 0.05). People construct, rather, had a mediatory role between change culture and organizational agility.

To find out the enabling mechanism between change culture and organizational agility, mediation effects were also analyzed. Serial mediation path including organizational learning and people constructs showed a positive and significant indirect effect (unstandardized bootstrap estimate: 0.134; p: 0.027 < 0.05). Change culture was found to positively affect organizational learning which enables the development of flexible and empowered human resources and finally helps to increase agility. Human resources are critical for organizational agility. A change culture that also focuses on and enhances learning, eventually, creates flexible, empowered, engaged and learning human resources (Holbeche, 2018). As a result, employees provide quicker and more appropriate responses which lead to agility (Gunasekaran *et al.*, 2019; Harraf *et al.*, 2015).

Besides that, serial mediation path including organizational learning, technology and external relations constructs also exhibited a positive and significant indirect effect (unstandardized bootstrap estimate: 0.110; p: 0.003 < 0.05). In this path, change culture strongly enhances organizational learning which positively affects technology awareness and use in the organization. In this way, technology helps to create external relations with customers, suppliers and other firms. Eventually, the partnership helps to increase organizational agility. These mediation effects are classified as complementary mediation. In complementary mediation, it is considered that some mediators could be neglected according to Zhao *et al.* (2010). Since there are two serial mediation paths, it is not very likely for this model. However, further mediators can be explored in future research.

These research findings show that change culture has a positive and significant effect on organizational agility both directly and indirectly. This makes change culture a significant organizational agility enabler which also has an impact on other enablers, as well. This may be an indication that change culture acts as an antecedent for several agility enablers.

4.5.4. Organizational Learning

The fourth hypothesis suggested a significant and positive effect of organizational learning on organizational agility. Analysis results showed that the relationship is close to 0 and not significant (standardized regression weight: -0.026; p: 0.882 > 0.05). Hence, the hypothesis could not be supported. Similarly, in the study of Budiarti *et al.* (2020), the effects

of internal and external learning on supply chain agility were found to be insignificant. On the other hand, organizational learning was shown to have a strong, positive and significant effect on people (standardized regression weight: 0.880; p: 0.000 < 0.05). This relation reveals the significance of skill development, knowledge sharing, and training on creating flexible, multi-skilled, empowered employees, and developing cross-functional and self-managed teams. Sharp *et al.* (1999) stated that flexible human resources can be seen as a result of training and education. Further, organizational learning was found to have a strong, positive and significant effect on technology (standardized regression weight: 0.825; p: 0.000 < 0.05). This relation implies that skill development, knowledge sharing, training and education also helps to increase the awareness of current technologies, the use of adequate technology in design and other processes, and the use of information and communication technology. This result is in line with the findings of Hassan *et al.* (2013) based on an extensive literature review proposing organizational learning as an antecedent of information technology.

When mediation effects were examined, people construct was found to mediate the relation between organizational learning and organizational agility. An indirect, positive and significant effect was reported (unstandardized bootstrap estimate: 0.154; p: 0.029 < 0.05). Besides, the serial mediation path including technology and external relations was reported to have an indirect, positive and significant mediation effect (unstandardized bootstrap estimate: 0.126; p: 0.004 < 0.05). These mediation effects indicate indirect-only mediation, where the direct effect is insignificant.

In some studies, organizational learning was found to show a significant and positive effect on organizational agility (Govuzela and Mafini, 2019; Tsou and Cheng, 2018). However, these studies did not include mediators in their models. The main cause for the insignificant direct effect could be the inclusion of mediators which show a strong relation with organizational learning. Hence, this study may imply that organizational learning has an indirect effect on organizational agility, rather than a direct effect. Learning, sharing knowledge and training can help to enable organizational agility through flexible human resources, use of technology and external relations.

4.5.5. People

The fifth hypothesis proposed a significant and positive effect of people on organizational agility. It was supported according to findings that reveal a weak and positive relation (standardized regression weight: 0.215; p: 0.032 < 0.05). This finding is consistent with existing studies. A large number of studies emphasized the important role of flexible human resources, empowerment, and development of cross-functional teams in organizational agility (Carvalho *et al.*, 2020; Gunasekaran *et al.*, 2019; Khatri *et al.*, 2018; Žitkienė and Deksnys, 2018; Muduli, 2017; GhalichKhani and Hakkak, 2016; Eshlaghy *et al.*, 2010; Yusuf *et al.*, 1999). Multi-skilled and flexible human resources can be reassigned in required circumstances (Hoyt, 1996) which enhances responsiveness and flexibility. Empowerment of employees helps to make decisions quickly and appropriately (Gunasekaran *et al.*, 2019; Harraf *et al.*, 2015; Sharp *et al.*, 1999). Teamwork creates functional working units and enables empowerment, decentralized decision making and control (Gunasekaran *et al.*, 2019). As a result, human resources enable organizational agility.

4.5.6. Technology

The sixth hypothesis postulated the significant and positive effect of technology on organizational agility. However, this relation was found insignificant (standardized regression weight: 0.074; p: 0.417 > 0.05) and the hypothesis could not be supported. When existing studies were investigated, even though most of the studies implied that technology, information technology or information systems enable agility (Zhang and Sharifi, 2007; Overby *et al.*, 2006; Sambamurthy *et al.*, 2003), some of them concluded that they disenable agility (van Oosterhout *et al.*, 2005) which was classified in the study of Lu and Ramamurthy (2011). However, these studies mostly consider only the relations between technology and agility without including other enablers. Considering other enablers in the model, technology could have relatively less effect on organizational agility of Turkish construction firms. Further, this study inspected awareness and use of technology and information and communication technology. In a future study, technologies used in construction processes can be evaluated detailly.

Technology has a strong, positive and significant direct effect on external relations (standardized regression weight: 0.804; p: 0.000 < 0.05). Technology was found to have an indirect effect, rather than a direct effect on organizational agility. When mediation effects were inspected, there was a significant and positive mediation effect of external relations (unstandardized bootstrap estimate: 0.167; p: 0.003 < 0.05). This mediation is classified as indirect-only mediation where the direct effect is insignificant.

Technology use has a great potential in relations with customers, suppliers and partners. Because, technology helps to share visible, updated, data and information with partners (Liu *et al.*, 2016). In turn, it helps to deal with competitive, changing and dynamic environments (Lee and Yang, 2014). Hence, the effect of technology on organizational agility through external relations is consistent with the findings of several studies. Poloie *et al.* (2012) showed the relation between technology, information technology and partnership in achieving supply chain agility in mass construction. Similarly, Agarwal *et al.* (2007) found out that the use of information technology is a strong enabler of supply chain agility. Liu *et al.* (2016) emphasized that cloud-based information technology structure enhances organizational agility through relations with partners. Moreover, Felipe *et al.* (2016) similarly found that information system capabilities have more of an indirect impact rather than a direct impact on organizational agility.

4.5.7. External Relations

The seventh hypothesis postulated the significant and positive effect of external relations on organizational agility. This hypothesis was supported with weak, positive and significant direct effect (standardized regression weight: 0.233; p: 0.004 < 0.05). Similar to study findings, Lee and Yang (2014) also found a positive and significant relationship between network ties and organizational agility constructs. Globalization and competition force companies to develop external relations. In order to gain a competitive advantage, most companies create partnerships, collaborate with other firms, share their resources and use complementary resources of partners (Liu *et al.*, 2016). Supply chains and networks provide cooperative relations which help to deal with environmental change (Lee and Yang, 2014). Hence, external relations have a role to enable organizational agility.

5. CONCLUSIONS

Complex, dynamic and uncertain business environments, increasing globalization, extreme competitiveness, developing technologies and changing stakeholder requirements create a harsh environment for companies. Along with these challenges, the COVID-19 pandemic increased volatility and caused significant social, environmental, and economic consequences globally. Agility is a significant concept that helps organizations to survive and to stay competitive in an unpredictable and rapidly changing environment. Considering the research gap of organizational agility literature in the context of the construction industry, this study investigated organizational agility of Turkish construction companies.

A conceptual model was developed based on an in-depth literature review and unstructured interviews. Environmental changes which are political, economic, sociocultural, technological, environmental, legal changes, the threat of new entrants and rivalry among competitors; organizational agility which is measured with sensing, responsiveness, flexibility and competency; and agility enablers which are flat organizational structure, change culture, organizational learning, people, technology and external relations were included in the model. To test the hypothesized relations, data was collected from practitioners working in Turkish construction companies through an online questionnaire survey based on a 5-point Likert scale. The collected data were examined and analyzed through the SEM method using SPSS and AMOS software programs. Accordingly, several research findings were gained.

5.1. Summary of Major Findings

This study provided a review of organizational agility definitions and key concepts recurring in the definitions. In the scope of this study, organizational agility was defined as the ability of an organization to perceive internal and external changes and respond properly. Organizational agility was further explained based on similar and relevant concepts such as flexibility, adaptability, resilience and lean. Agility drivers, capabilities and enablers were detailed according to literature. Models and assessment methods of agility were discussed along with methodologies used in the existing literature. Additionally, agility in the

construction industry was reviewed including studies related to agile project management, supply chain agility and organizational agility.

Environmental changes in the Turkish construction industry were reviewed based on data collected from global reports and data sources of official websites. Both reviewed data and results from the questionnaire survey revealed that economic factors have an extreme and significant impact on the Turkish construction industry. The impact of political and legal factors was also high. Further, the level of rivalry among competitors was high. These show that the environment pressures the construction industry and creates undesirable conditions, especially in recent years. Hence, this study shows that there is a need for organizational agility in Turkish construction companies.

The ratings of questionnaire items were investigated based on different classifications through visual radar charts. Respondents from top management level perceived and rated organizational agility items higher, while architects rated lower, comparingly. Top management level also rated organizational agility enablers such as change culture, organizational learning, empowerment of employees, technology use and external relations, compared to other respondents. This may propose that the top management level perceives the level of organizational agility of the company higher.

Considering organization size, micro-sized companies were found to be impacted by the threat of new entrants and rivalry among competitors more than other groups. Large companies rated most of the organizational agility enablers lower than others such as flat organizational structure, change culture, organizational learning, empowerment of employees, cross-functional teamwork, and external relations. This may show that micro-sized companies may be more vulnerable to some environmental changes. On the other hand, large companies seem to show fewer characteristics that can enable agility.

When organization age is considered, young companies mostly rated organizational agility items and organizational agility enablers higher than medium-aged and old companies. This may reveal that young companies have higher organizational agility compared to other groups. Considering work sectors, public sector companies are less affected by rivalry among competitors, comparingly. Public sector companies rated organizational agility items

and organizational agility enablers lower. This may show that public sector companies do not need to be agile since they are not affected by the environment harshly as others.

When the percentage of international projects that companies have is considered, companies that do not have international projects rated the threat of new entrants higher, compared to others. Companies with at least 50% international projects, rated some organizational agility items higher, such as responsiveness and flexibility. Even though there is no clear evidence, companies that have international projects may show higher organizational agility characteristics in some aspects, comparingly.

According to analysis results, proposed hypotheses were assessed. Environmental changes were not found to have a direct effect on organizational agility. To the best of our knowledge, there was not any study giving empirical evidence about the direct relationship between environmental changes and organizational agility. In the light of this finding, it can be proposed that this effect can be indirect rather than a direct effect or environmental change may act as a moderator.

External relations construct was found to have a weak, positive and significant direct effect on organizational agility. This may show that organizations that develop relations with customers, suppliers and partners tend to sense the changes, respond to them quickly and appropriately, have flexible resources and adequate competency. Technology was found to affect organizational agility indirectly rather than directly. It was found to have a strong, positive and significant direct effect on external relations. Further, external relations act as a mediator between technology and organizational agility. This finding is reasonable because technology helps to share data with partners within a virtual environment. Hence, it helps to develop relations, which in turn enables organizational agility. People construct was found to have a weak, positive direct effect on organizational agility. This shows that flexible human resources, empowerment of employees, cross-functional and self-management teams are significant for achieving organizational agility.

Organizational learning was found to affect organizational agility indirectly rather than directly. Organizational learning was found to have positive and significant direct effects on people and technology. Besides that, people construct (first mediation path), and technology

and external relations constructs (second mediation path) also act as mediators in the relationship between organizational learning and organizational agility. These findings show that learning, sharing knowledge and training can help to enable organizational agility through flexible human resources, use of technology and external relations. It can be implied that if organizational learning could not enhance human resources and technology, it possibly could not enable organizational agility.

The flat organizational structure was found to have a weak, negative direct effect on organizational agility, contrary to the proposed positive effect. This finding is similar to some studies. It can be explained with some problems in the implementation of flat organizational structure such as unbalanced power dynamics and the development of hidden hierarchies. Hierarchy to a certain extent may be needed. On the other hand, the flat structure was found to have a weak, positive indirect effect on organizational agility. Empowerment of employees, flexible workforce and teamwork mediates the relation in between. It is interesting that in the absence of this mediation, the flat structure may impede organizational agility to a little extent.

Change culture was found to have a moderate, positive direct effect on organizational agility. This finding implies that companies need to have a culture that embraces change, supports continuous improvement and innovation in order to achieve organizational agility. Further, change culture had a strong, positive effect on organizational learning. This shows that organizational culture that supports change enables learning in the organization. Change culture had also a positive indirect effect on organizational agility through mediators of organizational learning and people. Culture of change provides an environment to share new ideas, seek new solutions and improvements, which leads to learning. Organizational learning, knowledge sharing, training and education create flexible, empowered, engaged human resources and teamwork. As a result, employees provide quicker and more appropriate responses which lead to agility. Further, change culture had also a positive indirect effect on organizational agility through mediators of organizational learning, technology and external relations. Change culture enhances organizational learning which helps to increase technology awareness and use. Technology, in turn, helps to develop relations with customers, suppliers and partners. As a result, organizational agility can be

achieved. These findings support that change culture is a critical enabler of organizational agility, considering both direct and indirect effects.

There were relatively few empirical studies on organizational agility in the construction industry context and there were few models that investigate organizational agility enablers and their interrelationships. As a result, this study can be considered exploratory. Hence, some of the relations were not found to have significant effects. However, these findings may help and guide researchers aiming to investigate organizational agility in the construction industry.

5.2. Theoretical Contributions

The literature lacks a comprehensive model. Existing studies mostly model the relation between organizational agility and performance. There are some studies that investigate enablers; however, information technology, organizational culture or knowledge management were mostly included in the models, separately. This study develops a comprehensive model investigating organizational agility, organizational agility drivers, organizational agility enablers, and their interrelations. This study also reveals several mediators between the relationship of enablers and organizational agility.

The construction industry literature, especially, has scarce sources on organizational agility. This study contributes to the literature by employing an in-depth literature review, developing a conceptual model and giving empirical evidence from the Turkish construction industry. Further, this study portraits the current environmental situation of the Turkish construction industry based on data from global reports and official statistics. The developed model may guide researchers who aim to work on organizational agility in the construction industry context.

5.3. Practical Implications

This study may help to increase awareness about organizational agility and may encourage construction practitioners to apply and reap the benefits of organizational agility. Companies may attempt to adopt the main agility capabilities which are sensing,

responsiveness, flexibility and competency. The companies may utilize the PESTEL framework to sense and analyze their environment which is specific to the company. Provided data about the environmental changes may help practitioners to recognize opportunities and threats in the Turkish construction industry. Further, provided empirical data from the Turkish construction industry may give insights to construction companies. Presented questionnaire results and comparisons among different groups may help practitioners to see the perception of organizational agility by various groups in the Turkish construction industry.

Relevant discussions about enablers of organizational agility may present a guide to construction industry companies in Turkey. Construction companies aiming to create an agile organization may consider presented enablers and try to develop required skills. Based on the research findings presented, the following recommendations are proposed for construction companies that implement or consider implementing organizational agility.

- Construction companies are recommended to observe changes in the environment and their possible impacts. Since the impact of changes can vary from company to company, the changes should be evaluated considering political, economic, sociocultural, technological, environmental, legal changes, the threat of new entrants and rivalry among competitors. Especially, political and economic changes seem to be significant in Turkish construction industry. Accordingly, companies should develop strategies.

- Based on the average scores of organizational agility items, identifying and eliminating non-value adding activities was rated as the lowest item. This may cause inefficiencies in the processes, hence, the companies are recommended to develop their competencies and increase effectiveness and efficiency. The other item with a low score was detecting tendencies earlier proactively. This may show the lack of proactive behavior of Turkish construction companies. Hence, it is recommended to take precautions and optimize plans according to changes. Another item with a low score was detecting opportunities and threats. Hence, the companies need to place emphasis on observing the circumstances to recognize opportunities and threats.

- Based on the average scores of organizational agility enablers items, flat organizational structure had the lowest score. It is recommended that companies should review their organizational structure. Even though a stable foundation is needed, the voice of the employees should also be heard, and silos in the organization should be eliminated. It was followed by items of multi-skilled, flexible human resources and empowered employees. Hence, companies are advised to improve human resources and give authority and power to employees for decision making. Further, cross functional and self-managed teamwork was also rated low. In the Turkish construction companies, teamwork should be encouraged, opportunities should be created for autonomous teams. In this respect, management may play an important role.

- Change culture is a significant enabler of agility, hence, organizations are recommended to provide an environment that supports change, continuous improvement, experimentation and innovation. Companies are advised to ensure the change culture with the help of management and employees. Kaizen (continuous improvement) philosophy can be adopted in the company. It is recommended for companies to support innovation and experimentation despite the traditional nature of the construction industry.

- Based on the finding that organizational learning has an indirect effect on organizational agility rather than a direct effect, companies should invest in learning in the organization. Because, increased learning helps to develop human resources and technology use, as a result, to enhance organizational agility. Companies should transform their knowledge and experience into their projects, services and strategies.

- Construction companies are advised to put emphasis on developing human capital. They should improve human capital, and trust, empower and give employees the necessary authority to make decisions. Without qualified human resources, agility could not be achieved. Further, companies may adopt Scrum methodology to increase teamwork.

- Companies are also advised to use information and communication technology which is one of the essential requirements of today's business world. Technology can be used to monitor changes, observe opportunities and threats and recognize customer expectations. Companies are recommended to form virtual organizations with other firms which helps them to reach up-to-date information.

- Construction companies are recommended to develop close relationships with customers, suppliers and partners. Because resources of the company may not be adequate to deal with changes, and creating a network enables sensing the environment, responding to changes and being flexible with the help of partners.

Based on the research findings and suggestions of several studies (Walter, 2021; Lin et al., 2006; Sharifi and Zhang, 1999), some recommendations were presented for management level and organizational level as can be seen in Table 5.1.

Table 5.1. Recommendations for management level and organization level.

	Management level	Organizational level
Agility drivers	• Observe and detect changes in the environment • Evaluate threats and opportunities • Rank and prioritize agility drivers	• Develop a mechanism to detect changes and employ required resources for it • Determine the level of need for agility
Agility capabilities	• Determine agility capabilities that should be developed in response to agility drivers	• Determine the level of agility of the company
Agility enablers	• Determine the practices that enable required agility capabilities • Check the alignment of agility enablers with the existing situation of the company	• Develop an action plan according to determined practices to reach the desired agility level

5.4. Limitations of the Study and Recommendations for Future Work

This study covers construction companies within a single geographical area i.e., Turkey. Hence, the generalization of the results to other countries should be considered with caution. It should be noted that a different sample may give different results. One of the concerns of the collected data in the Turkish construction industry is that there is not any company implementing organizational agility completely, to the best of our knowledge. Even though most of the construction companies are not familiar with agility, it was considered to find out the level of agility that they apply in their operations. Hence, to generalize the results, the model should be validated with a larger sample size including construction companies from different countries.

In this study, different groups are compared according to visual radar charts. They should be considered as a recommendation for future research direction. They need to be tested statistically before implying solid findings. In order to test them appropriately, every group should have an adequate number of responses. Hence, in future studies, a multi-group analysis could be done with a larger sample to examine the effect of organization size, organization age, work sector, the role of the respondent or further meaningful groups. Besides, statistical tests could be conducted to determine the difference between groups.

Another limitation can be the cross-sectional nature of the study. The data was collected at a single point in time. On the other hand, a longitudinal study may give significant insights into the research of organizational agility. Another recommendation is that case study methodology can be used in future work to better understand the opinion of construction industry practitioners and companies. Qualitative data can provide evidence to imply further meaningful results from quantitative data. Besides, case study methodology can help to analyze the environment, applied practices, available resources, and other concepts better.

In future studies, based on the findings provided in this study, the model can be improved. Other agility enablers could be integrated into the model, agility drivers could be modeled as moderators. On the other hand, the effect of organizational agility on organizational performance or success can be investigated. The findings may encourage

construction firms in case of positive performance outcomes. Further, the relationship between organizational agility and different dimensions of agility such as workforce agility, business processes agility can be investigated in the construction industry.

There is a clear research gap in the construction industry literature on the topic of organizational agility. In future studies, an organizational agility index for construction companies may be established through fuzzy logic which is one of the most commonly used methods in developing an agility index. Based on the developed index, construction companies can be classified by clustering method according to their agility level. Further, an organizational agility implementation framework for construction companies can be developed. This may help companies that aim to implement agility.

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APPENDIX A: QUESTIONNAIRE SURVEY

A.1. Part 1: Impact of Environmental Changes in the Construction Industry

Please indicate the impact of the following environmental factors on the Turkish construction industry in the present and near future.

	1: very low impact	2	3	4	5: very high impact
Political changes (actions of government bodies etc.)					
Economic changes (growth, interest, inflation, unemployment rates, etc.)					
Sociocultural changes (demographic trends, culture and values, etc.)					
Technological changes (newly introduced technologies etc.)					
Environmental/ecological changes					
Legal changes (laws, regulations, etc.)					
The threat of new entrants to the Turkish construction industry					
Rivalry among existing competitors in the Turkish construction industry					

A.2. Part 2: Organizational Agility Capabilities

Organizational agility: the ability of firms to sense internal and external changes and respond quickly and efficiently to changes within time, cost, quality considerations. Agile organizations take advantage of opportunities and mitigate threats.

What is the level of organizational agility of your company according to your perception?

1: very low	2	3	4	5: very high

To what extent do you agree with the following statements about your organization?

	I strongly disagree 1	2	3	4	I strongly agree 5
The organization monitors internal and external data.					
The organization turns information into actionable knowledge.					
The organization fully understands and analyses changes (such as changes in market, customer requirements, technology, social, legal, internal, etc.).					
The organization detects unrecognized opportunities and threats.					
The organization is able to give immediate reactions to changes, take decisions and implement them efficiently and quickly.					
The organization detects tendencies earlier proactively and optimizes the organizational strategy accordingly.					
The organization is able to recover from and deal with changes.					
The organization takes advantage of opportunities, took advantage of opportunities recently (by developing new projects in a different area, sector, product type, type of partnership, etc.)					
The organization and mitigates threats, mitigated threats (effect of the pandemic, economic instability, etc.) recently.					
The organization has a set of resources (multi-skilled human resources, a variety of investments, mixed-use technology, etc.) and is able to reconfigure and reallocate them easily as circumstances require.					
The organization is able to reorganize the processes and their relationships in situations that may necessitate this action.					
The organization is able to adapt to the changing conditions.					
The organization develops a range of possible solutions (pre-designed or just-in-time) to respond to changes.					
The organization is able to achieve organization's goals such as time, cost and quality requirements.					
The organization has operational efficiency and effectiveness.					
The organization is able to identify and eliminate non-value adding processes.					

A.3. Part 3: Organizational Agility Enablers

To what extent do you agree with the following statements about your organization?

	I strongly disagree 1	2	3	4	I strongly agree 5
The organizational structure is flat and horizontal with less hierarchy.					
The organization has a change culture.					
The organizational culture supports continuous improvement.					
The organization has a culture of innovation that supports experimentation and innovative ideas.					
The organization is skilled to transform experience and knowledge gained into projects, services, and new strategies.					
The organization cares skill development and knowledge sharing.					
The organization provides continuous training, education and development.					
The organization employs multi-skilled and flexible human resources.					
In the organization, employees are empowered and trusted, they have the authority and power to make decisions individually.					
In the organization, teamwork is clearly observed.					
In the organization, there are cross-functional and self-managed teams.					
The organization is aware of current technologies.					
The organization uses adequate and right mix of technology in design/production/construction processes.					
The organization uses information and communications technology.					
The organization has close and trust-based relationships with suppliers.					
The organization cooperates with other firms (suppliers, customers, competitors, etc.).					
The organization communicates and develops relations with customers.					

A.4. Part 4: General Information about the Respondent and Company

Your position in the company

- ☐ Top-Level Management (Board of Directors, Chief Executive Officer, General Manager, Managing Director, Project Manager, etc.)
- ☐ Middle-Level Management (Department Head, Branch Manager, etc.)
- ☐ Engineer
- ☐ Architect
- ☐ Other _____

Your experience in the construction industry (in years) _____

Company's total number of employees

- ☐ < 10
- ☐ 10-49
- ☐ 50-250
- ☐ > 250

Company's annual turnover (TL)

- ☐ < 3 million TL
- ☐ 3 – 25 million TL
- ☐ 25 – 125 million TL
- ☐ >125 million TL

Company's years of operation in the construction industry (in years) _____

The location of your company's head office (city) _____

What is the percentage share of international projects in your company's total business volume?

- ○ None
- ○ <25%
- ○ 25-50%
- ○ 50-75%
- ○ 75-100%

Work sector that your company carries out the projects

- ☐ Public sector
- ☐ Private sector

Field(s) of operation of the company

- ☐ Infrastructure projects (bridge, road, water, waste, energy, etc.)
- ☐ Commercial projects (hospital, university, shopping center, sports facility, etc.)
- ☐ Industrial projects (factory, plant, etc.)
- ☐ Residential building projects
- ☐ Other _____

Type of the company

- ☐ Client/Owner
- ☐ Investor
- ☐ General Contractor
- ☐ Subcontractor
- ☐ Architecture company
- ☐ Engineering company
- ☐ Consultant company
- ☐ Other _____

APPENDIX B: DESCRIPTIVE STATISTICS

Table B.1. Descriptive statistics of the measured variables in descending order of means (N=251).

	Median	Mean	Std. Deviation	Skewness		Kurtosis	
				Statistic	SE	Statistic	SE
Env2	5	4.64	0.650	-2.385	0.154	7.935	0.306
Env1	5	4.48	0.797	-1.651	0.154	2.796	0.306
Ext3	4	3.84	1.106	-0.826	0.154	-0.030	0.306
Env6	4	3.84	1.020	-0.578	0.154	-0.294	0.306
Sens1	4	3.68	1.064	-0.592	0.154	-0.164	0.306
Env8	4	3.61	1.229	-0.675	0.154	-0.430	0.306
Ext2	4	3.57	1.189	-0.656	0.154	-0.439	0.306
Ext1	4	3.56	1.190	-0.655	0.154	-0.367	0.306
Flex3	4	3.55	1.146	-0.491	0.154	-0.493	0.306
Peop3	4	3.53	1.194	-0.472	0.154	-0.652	0.306
Resp4	4	3.49	1.111	-0.432	0.154	-0.462	0.306
Tech1	4	3.45	1.149	-0.445	0.154	-0.606	0.306
Tech2	4	3.45	1.121	-0.363	0.154	-0.697	0.306
Env4	3	3.44	1.128	-0.125	0.154	-0.809	0.306
Sens3	4	3.41	1.089	-0.413	0.154	-0.414	0.306
Comp1	3	3.40	1.044	-0.419	0.154	-0.206	0.306
Sens2	3	3.36	1.050	-0.363	0.154	-0.326	0.306
Flex2	3	3.35	1.126	-0.393	0.154	-0.507	0.306
Resp1	4	3.33	1.236	-0.326	0.154	-0.981	0.306
Orgl2	3	3.27	1.296	-0.301	0.154	-0.990	0.306
Orgl1	3	3.27	1.216	-0.317	0.154	-0.800	0.306
Tech3	3	3.27	1.267	-0.272	0.154	-0.987	0.306
Resp5	3	3.25	1.192	-0.296	0.154	-0.697	0.306
Comp2	3	3.24	1.170	-0.378	0.154	-0.708	0.306
Flex4	3	3.22	1.206	-0.244	0.154	-0.894	0.306
Flex1	3	3.22	1.215	-0.252	0.154	-0.914	0.306
Resp3	3	3.20	1.135	-0.216	0.154	-0.801	0.306
Env5	3	3.18	1.091	-0.035	0.154	-0.636	0.306
Sens4	3	3.16	1.095	-0.320	0.154	-0.530	0.306
Orgc2	3	3.16	1.292	-0.222	0.154	-1.075	0.306
Env3	3	3.14	1.090	0.048	0.154	-0.617	0.306
Resp2	3	3.10	1.203	-0.144	0.154	-0.978	0.306
Orgl3	3	3.10	1.425	-0.186	0.154	-1.314	0.306
Orgc3	3	3.08	1.299	-0.108	0.154	-1.091	0.306
Peop4	3	3.06	1.286	-0.093	0.154	-1.061	0.306
Comp3	3	3.05	1.243	-0.099	0.154	-1.007	0.306
Peop2	3	3.05	1.289	-0.169	0.154	-1.031	0.306
Orgc1	3	3.03	1.268	0.011	0.154	-1.033	0.306
Env7	3	3.03	1.232	-0.009	0.154	-0.873	0.306
Peop1	3	2.91	1.324	-0.025	0.154	-1.138	0.306
Flat	3	2.91	1.393	0.031	0.154	-1.283	0.306

Table B.2. Descriptive statistics of the measured variables in descending order of means (N=238).

	Median	Mean	Std. Deviation Statistic	Skewness		Kurtosis	
				Statistic	SE	Statistic	SE
Env2	5	4.68	0.544	-1.453	0.158	1.183	0.314
Env1	5	4.52	0.716	-1.347	0.158	1.074	0.314
Ext3	4	3.87	1.079	-0.869	0.158	0.160	0.314
Env6	4	3.83	1.005	-0.538	0.158	-0.342	0.314
Sens1	4	3.70	1.059	-0.626	0.158	-0.126	0.314
Env8	4	3.64	1.188	-0.694	0.158	-0.299	0.314
Ext2	4	3.60	1.164	-0.673	0.158	-0.360	0.314
Ext1	4	3.58	1.176	-0.687	0.158	-0.288	0.314
Flex3	4	3.56	1.119	-0.504	0.158	-0.402	0.314
Peop3	4	3.53	1.186	-0.471	0.158	-0.616	0.314
Resp4	4	3.52	1.101	-0.444	0.158	-0.444	0.314
Tech1	4	3.47	1.128	-0.434	0.158	-0.593	0.314
Env4	3	3.44	1.126	-0.111	0.158	-0.831	0.314
Tech2	4	3.44	1.115	-0.356	0.158	-0.706	0.314
Comp1	3.5	3.42	1.019	-0.444	0.158	-0.106	0.314
Sens2	3	3.42	1.015	-0.391	0.158	-0.157	0.314
Sens3	4	3.42	1.083	-0.425	0.158	-0.373	0.314
Resp1	4	3.39	1.206	-0.352	0.158	-0.929	0.314
Flex2	4	3.39	1.103	-0.432	0.158	-0.424	0.314
Orgl2	3.5	3.34	1.255	-0.343	0.158	-0.892	0.314
Orgl1	3	3.30	1.180	-0.333	0.158	-0.727	0.314
Comp2	3	3.29	1.156	-0.410	0.158	-0.619	0.314
Resp5	3	3.27	1.193	-0.316	0.158	-0.695	0.314
Tech3	3	3.27	1.261	-0.264	0.158	-0.978	0.314
Flex1	3	3.26	1.205	-0.294	0.158	-0.874	0.314
Flex4	3	3.25	1.184	-0.276	0.158	-0.833	0.314
Orgc2	3	3.24	1.248	-0.266	0.158	-0.986	0.314
Resp3	3	3.24	1.101	-0.219	0.158	-0.768	0.314
Env5	3	3.22	1.092	-0.071	0.158	-0.618	0.314
Sens4	3	3.20	1.076	-0.369	0.158	-0.429	0.314
Env3	3	3.18	1.045	0.089	0.158	-0.564	0.314
Orgl3	3	3.14	1.398	-0.239	0.158	-1.249	0.314
Orgc3	3	3.13	1.261	-0.133	0.158	-1.021	0.314
Resp2	3	3.11	1.177	-0.143	0.158	-0.937	0.314
Orgc1	3	3.09	1.224	0.011	0.158	-0.975	0.314
Comp3	3	3.08	1.240	-0.091	0.158	-1.009	0.314
Peop4	3	3.07	1.273	-0.123	0.158	-1.028	0.314
Peop2	3	3.06	1.268	-0.199	0.158	-0.990	0.314
Env7	3	3.03	1.203	-0.028	0.158	-0.791	0.314
Peop1	3	2.94	1.299	-0.057	0.158	-1.088	0.314
Flat	3	2.93	1.390	0.005	0.158	-1.282	0.314

APPENDIX C: CORRELATION MATRICES

Table C.1. Correlation matrix of environmental change items.

	Env1	Env2	Env3	Env4	Env5	Env6	Env7	Env8
Env1	1							
Env2	.345**	1						
Env3	.148*	.108	1					
Env4	-.059	-.083	.235**	1				
Env5	-.069	-.072	.269**	.563**	1			
Env6	.139*	.224**	.205**	.200**	.330**	1		
Env7	.026	.111	.171**	.246**	.294**	.266**	1	
Env8	.034	.167*	.027	.121	.145*	.218**	.533**	1

Table C.2. Correlation matrix of organizational agility items.

	Sens1	Sens2	Sens3	Sens4	Resp1	Resp2	Resp3	Resp4	Resp5	Flex1	Flex2	Flex3	Flex4	Comp1	Comp2	Comp3
Sens1	1															
Sens2	.742**	1														
Sens3	.690**	.749**	1													
Sens4	.616**	.632**	.681**	1												
Resp1	.607**	.633**	.676**	.687**	1											
Resp2	.587**	.602**	.681**	.753**	.747**	1										
Resp3	.539**	.558**	.574**	.579**	.670**	.710**	1									
Resp4	.552**	.550**	.566**	.638**	.632**	.641**	.618**	1								
Resp5	.509**	.503**	.503**	.598**	.580**	.626**	.592**	.644**	1							
Flex1	.488**	.541**	.564**	.539**	.531**	.555**	.532**	.607**	.632**	1						
Flex2	.554**	.622**	.649**	.627**	.673**	.667**	.625**	.648**	.705**	.762**	1					
Flex3	.576**	.597**	.657**	.656**	.641**	.673**	.548**	.648**	.622**	.605**	.747**	1				
Flex4	.574**	.593**	.637**	.633**	.682**	.687**	.601**	.626**	.618**	.599**	.747**	.796**	1			
Comp1	.575**	.580**	.604**	.607**	.575**	.642**	.548**	.612**	.675**	.600**	.672**	.690**	.689**	1		
Comp2	.528**	.572**	.596**	.595**	.604**	.669**	.606**	.570**	.568**	.528**	.668**	.705**	.703**	.735**	1	
Comp3	.512**	.548**	.536**	.586**	.609**	.662**	.537**	.512**	.462**	.492**	.632**	.593**	.622**	.569**	.727**	1

Table C.3. Correlation matrix of organizational agility enablers items.

	Flat	Orgc1	Orgc2	Orgc3	Orgl1	Orgl2	Orgl3	Peop1	Peop2	Peop3	Peop4	Tech1	Tech2	Tech3	Ext1	Ext2	Ext3
Flat	1																
Orgc1	.393**	1															
Orgc2	.353**	.809**	1														
Orgc3	.388**	.761**	.859**	1													
Orgl1	.337**	.660**	.716**	.711**	1												
Orgl2	.341**	.667**	.764**	.723**	.829**	1											
Orgl3	.318**	.621**	.740**	.683**	.693**	.783**	1										
Peop1	.315**	.566**	.649**	.651**	.648**	.642**	.658**	1									
Peop2	.405**	.592**	.647**	.649**	.679**	.719**	.657**	.753**	1								
Peop3	.343**	.578**	.657**	.602**	.628**	.700**	.595**	.564**	.641**	1							
Peop4	.349**	.559**	.603**	.559**	.537**	.629**	.599**	.585**	.641**	.671**	1						
Tech1	.261**	.633**	.684**	.663**	.605**	.620**	.589**	.562**	.524**	.581**	.476**	1					
Tech2	.268**	.646**	.685**	.650**	.629**	.665**	.645**	.593**	.555**	.643**	.546**	.849**	1				
Tech3	.218**	.613**	.621**	.575**	.542**	.544**	.620**	.590**	.520**	.558**	.498**	.706**	.775**	1			
Ext1	.302**	.585**	.641**	.560**	.623**	.609**	.552**	.535**	.605**	.588**	.587**	.566**	.617**	.552**	1		
Ext2	.230**	.555**	.610**	.527**	.638**	.654**	.590**	.508**	.522**	.584**	.535**	.579**	.650**	.597**	.800**	1	
Ext3	.224**	.549**	.638**	.571**	.622**	.623**	.545**	.497**	.456**	.512**	.419**	.614**	.646**	.536**	.657**	.696**	1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

APPENDIX D: STANDARDIZED REGRESSION WEIGHTS

Table D.1. Factor loadings of indicators on their corresponding constructs for the initial model.

		Bootstrap results			Bias correction at 95% level			
Latent Construct	Indicator	Mean	SE	Bias	Estimate	Confidence Intervals		p value
Organizational agility	Sens1	0.713	0.041	0.000	0.713	0.617	0.781	0.001
	Sens2	0.754	0.038	0.001	0.754	0.664	0.816	0.001
	Sens3	0.784	0.037	0.000	0.783	0.693	0.842	0.001
	Sens4	0.805	0.031	-0.001	0.806	0.738	0.859	0.001
	Resp1	0.819	0.024	0.000	0.818	0.762	0.858	0.001
	Resp2	0.852	0.021	-0.001	0.853	0.807	0.890	0.000
	Resp3	0.753	0.048	0.000	0.753	0.638	0.830	0.001
	Resp4	0.766	0.036	-0.001	0.767	0.688	0.829	0.001
	Resp5	0.747	0.034	-0.001	0.748	0.674	0.807	0.000
	Flex1	0.710	0.039	-0.001	0.710	0.624	0.778	0.001
	Flex2	0.837	0.023	0.000	0.837	0.785	0.876	0.001
	Flex3	0.823	0.026	-0.001	0.824	0.767	0.868	0.001
	Flex4	0.826	0.023	0.000	0.826	0.772	0.866	0.001
	Comp1	0.785	0.032	0.000	0.785	0.715	0.839	0.001
	Comp2	0.779	0.031	0.000	0.779	0.709	0.832	0.001
	Comp3	0.725	0.038	0.000	0.725	0.640	0.791	0.001
Change culture	Orgc1	0.846	0.024	0.000	0.847	0.794	0.889	0.000
	Orgc2	0.949	0.011	0.000	0.949	0.925	0.969	0.001
	Orgc3	0.906	0.019	0.000	0.906	0.862	0.937	0.001
Organizational learning	Orgl1	0.864	0.022	0.000	0.864	0.814	0.901	0.001
	Orgl2	0.910	0.017	0.000	0.910	0.869	0.939	0.001
	Orgl3	0.839	0.023	-0.001	0.840	0.789	0.879	0.000
People	Peop1	0.826	0.034	0.000	0.826	0.749	0.886	0.001
	Peop2	0.875	0.025	0.000	0.875	0.818	0.917	0.001
	Peop4	0.714	0.035	-0.001	0.714	0.640	0.779	0.000
Technology	Tech1	0.884	0.021	0.000	0.885	0.838	0.920	0.001
	Tech2	0.941	0.014	0.000	0.941	0.909	0.964	0.001
	Tech3	0.813	0.030	0.000	0.813	0.747	0.866	0.001
External relations	Ext1	0.865	0.029	0.000	0.865	0.799	0.912	0.001
	Ext2	0.899	0.027	0.000	0.899	0.837	0.943	0.001
	Ext3	0.788	0.034	-0.001	0.790	0.716	0.849	0.000

Table D.2. Standardized regression weights for the initial model.

Hypothesized Relationships				Bootstrap results			Bias correction at 95% level			
				Mean	SE	Bias	Estimate	Confidence Intervals (Lower and Upper Bound)		p value
H1a	Env1	→	Organizational agility	0.025	0.040	-0.001	0.027	-0.048	0.110	0.473
H1b	Env2	→	Organizational agility	0.037	0.042	0.002	0.035	-0.045	0.115	0.415
H1c	Env3	→	Organizational agility	0.031	0.046	-0.002	0.033	-0.055	0.122	0.456
H1d	Env4	→	Organizational agility	0.063	0.047	-0.001	0.064	-0.026	0.160	0.159
H1e	Env5	→	Organizational agility	-0.045	0.047	0.001	-0.046	-0.136	0.048	0.323
H1f	Env6	→	Organizational agility	0.052	0.047	0.000	0.052	-0.037	0.149	0.240
H1g	Env7	→	Organizational agility	0.036	0.052	0.000	0.036	-0.067	0.137	0.514
H1h	Env8	→	Organizational agility	-0.013	0.052	0.000	-0.013	-0.114	0.094	0.810
H2	Flat	→	Organizational agility	-0.104	0.045	0.002	-0.105	-0.195	-0.017	0.024
H2a	Flat	→	People	0.118	0.052	0.001	0.117	0.021	0.225	0.020
H2b	Flat	→	Technology	-0.024	0.053	-0.001	-0.023	-0.124	0.083	0.660
H2c	Flat	→	Organizational learning	0.048	0.049	0.002	0.045	-0.046	0.149	0.336
H3	Change culture	→	Organizational agility	0.464	0.134	-0.001	0.464	0.199	0.728	0.003
H3a	Change culture	→	Organizational learning	0.894	0.024	-0.001	0.895	0.842	0.936	0.000
H3b	Change culture	→	People	0.004	0.150	-0.017	0.021	-0.297	0.292	0.822
H4	Organizational learning	→	Organizational agility	-0.026	0.252	0.003	-0.029	-0.564	0.444	0.882
H4a	Organizational learning	→	People	0.871	0.148	0.015	0.856	0.584	1.167	0.001
H4b	Organizational learning	→	Technology	0.824	0.033	0.000	0.824	0.748	0.881	0.001
H5	People	→	Organizational agility	0.199	0.156	0.002	0.197	-0.108	0.509	0.193
H6	Technology	→	Organizational agility	0.108	0.101	-0.004	0.112	-0.085	0.317	0.221
H6a	Technology	→	External relations	0.801	0.035	-0.002	0.803	0.725	0.862	0.000
H7	External relations	→	Organizational agility	0.209	0.088	-0.004	0.213	0.050	0.401	0.011

Table D.3. Factor loadings of indicators on their corresponding constructs for the final model.

		Bootstrap results			Bias correction at 95% level			
Latent Construct	Indicator	Mean	SE	Bias	Estimate	Confidence Intervals (Lower and Upper Bound)		p value
Organizational agility	Sens1	0.717	0.041	0.000	0.718	0.623	0.787	0.001
	Sens2	0.756	0.038	0.000	0.756	0.668	0.820	0.001
	Sens3	0.786	0.037	0.000	0.786	0.694	0.845	0.001
	Sens4	0.808	0.030	-0.001	0.809	0.742	0.861	0.001
	Resp1	0.822	0.024	0.000	0.822	0.769	0.862	0.001
	Resp2	0.855	0.021	-0.001	0.856	0.812	0.893	0.000
	Resp3	0.757	0.047	0.000	0.757	0.644	0.833	0.001
	Resp4	0.771	0.035	-0.001	0.773	0.695	0.832	0.000
	Resp5	0.753	0.033	-0.002	0.755	0.684	0.813	0.000
	Flex1	0.716	0.039	-0.001	0.717	0.634	0.784	0.000
	Flex2	0.841	0.022	-0.001	0.841	0.793	0.879	0.000
	Flex3	0.827	0.025	-0.001	0.828	0.775	0.872	0.000
	Flex4	0.830	0.022	-0.001	0.831	0.780	0.869	0.001
	Comp1	0.791	0.030	-0.001	0.791	0.724	0.844	0.000
	Comp2	0.782	0.030	-0.001	0.783	0.716	0.835	0.000
	Comp3	0.731	0.037	-0.001	0.732	0.651	0.796	0.000
Change culture	Orgc1	0.847	0.024	-0.001	0.847	0.795	0.889	0.001
	Orgc2	0.949	0.011	0.000	0.949	0.925	0.968	0.001
	Orgc3	0.906	0.019	0.000	0.906	0.862	0.937	0.001
Organizational learning	Orgl1	0.867	0.020	0.000	0.867	0.821	0.901	0.001
	Orgl2	0.913	0.016	0.000	0.912	0.874	0.939	0.001
	Orgl3	0.843	0.022	0.000	0.843	0.795	0.880	0.000
People	Peop1	0.828	0.034	0.000	0.828	0.753	0.886	0.001
	Peop2	0.875	0.024	0.000	0.875	0.820	0.917	0.001
	Peop4	0.716	0.035	-0.001	0.716	0.643	0.781	0.000
Technology	Tech1	0.885	0.020	0.000	0.885	0.839	0.920	0.001
	Tech2	0.941	0.014	0.000	0.941	0.910	0.965	0.001
	Tech3	0.814	0.030	0.000	0.815	0.752	0.867	0.001
External relations	Ext1	0.866	0.028	0.000	0.866	0.802	0.913	0.001
	Ext2	0.900	0.026	0.000	0.899	0.838	0.943	0.001
	Ext3	0.789	0.033	-0.001	0.791	0.718	0.849	0.000

Table D.4. Standardized regression weights for the final model.

Hypothesized Relationships				Bootstrap results			Bias correction at 95% level			
				Mean	SE	Bias	Estimate	Confidence Intervals (Lower and Upper Bound)		p value
H2	Flat	→	Organizational agility	-0.106	0.043	0.003	-0.109	-0.191	-0.024	0.015
H2a	Flat	→	People	0.131	0.051	0.001	0.129	0.034	0.235	0.007
H3	Change culture	→	Organizational agility	0.440	0.082	-0.001	0.441	0.273	0.593	0.000
H3a	Change culture	→	Organizational learning	0.899	0.020	0.000	0.899	0.856	0.935	0.000
H4a	Organizational learning	→	People	0.878	0.031	-0.001	0.880	0.814	0.934	0.000
H4b	Organizational learning	→	Technology	0.824	0.031	-0.001	0.825	0.757	0.881	0.000
H5	People	→	Organizational agility	0.214	0.095	0.000	0.215	0.021	0.393	0.032
H6	Technology	→	Organizational agility	0.076	0.093	0.002	0.074	-0.117	0.257	0.417
H6a	Technology	→	External relations	0.802	0.034	-0.002	0.804	0.729	0.863	0.000
H7	External relations	→	Organizational agility	0.231	0.084	-0.002	0.233	0.080	0.409	0.004

APPENDIX E: RADAR CHARTS

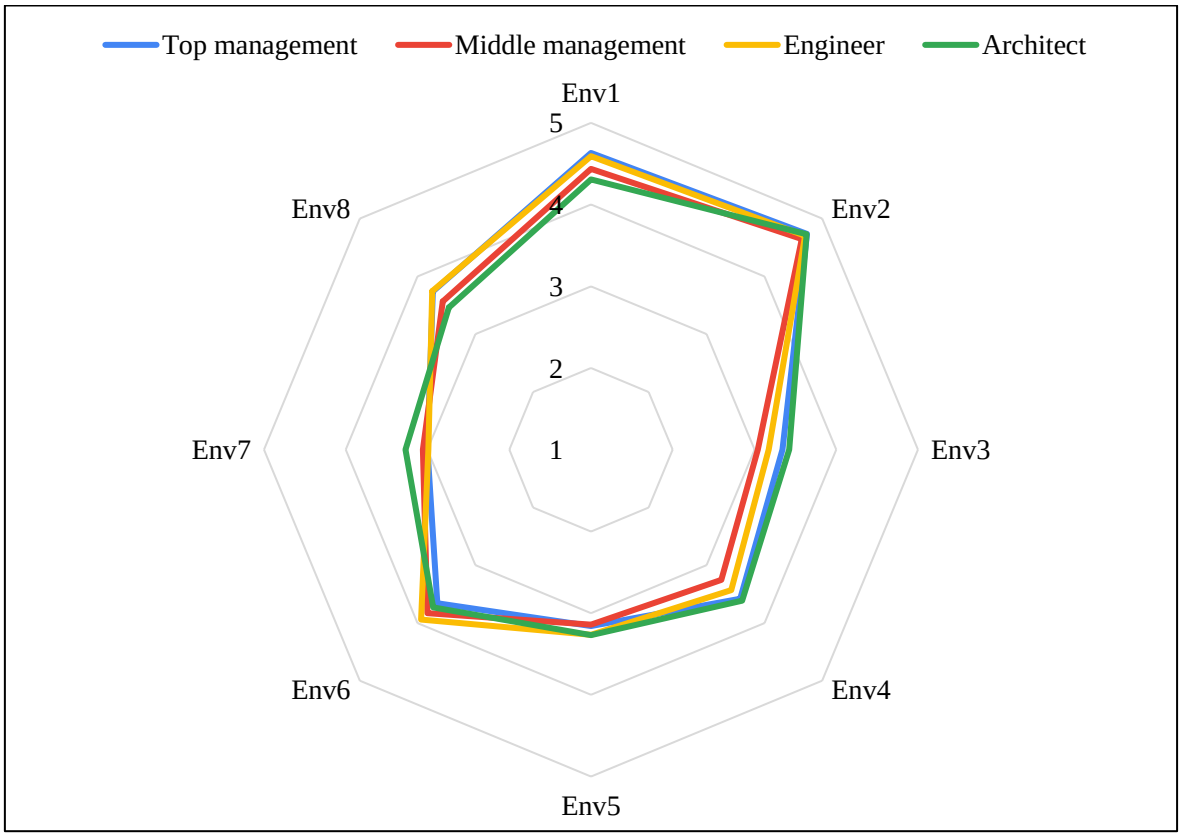

Figure E.1. Environmental change factors according to the role of the respondent.

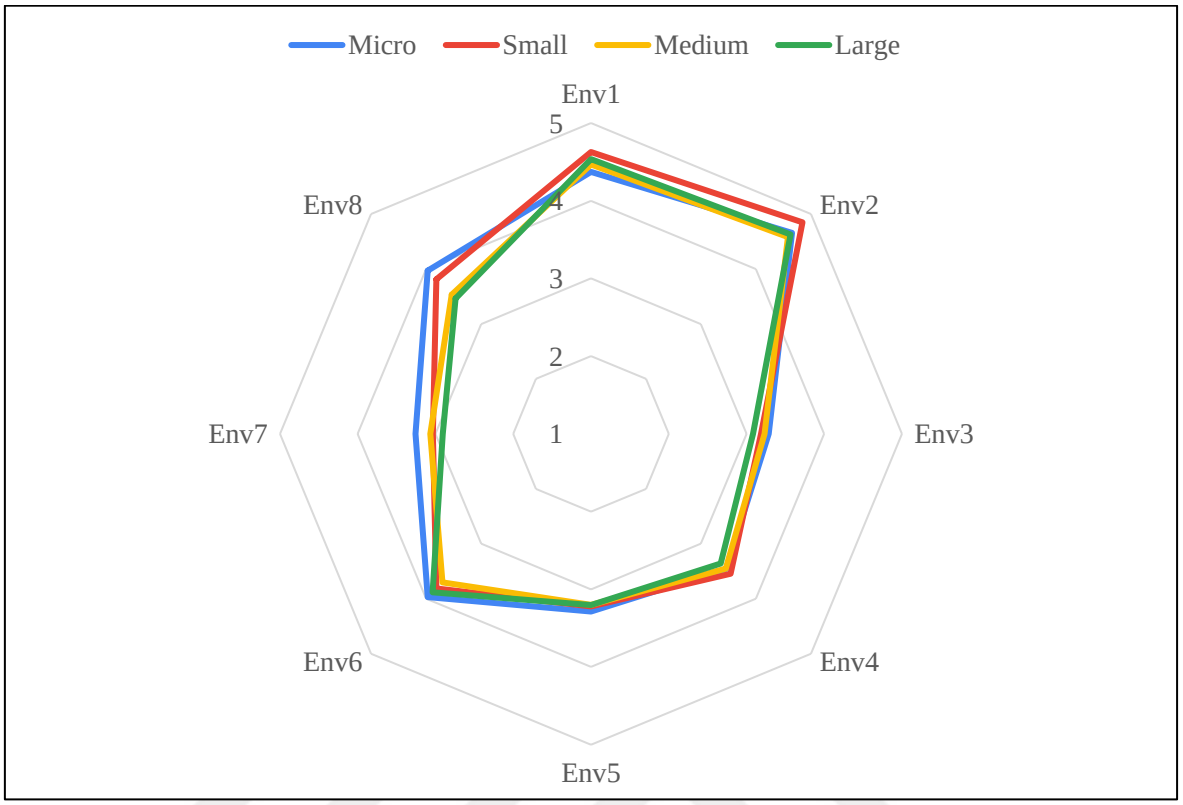

Figure E.2. Environmental change factors according to organization size.

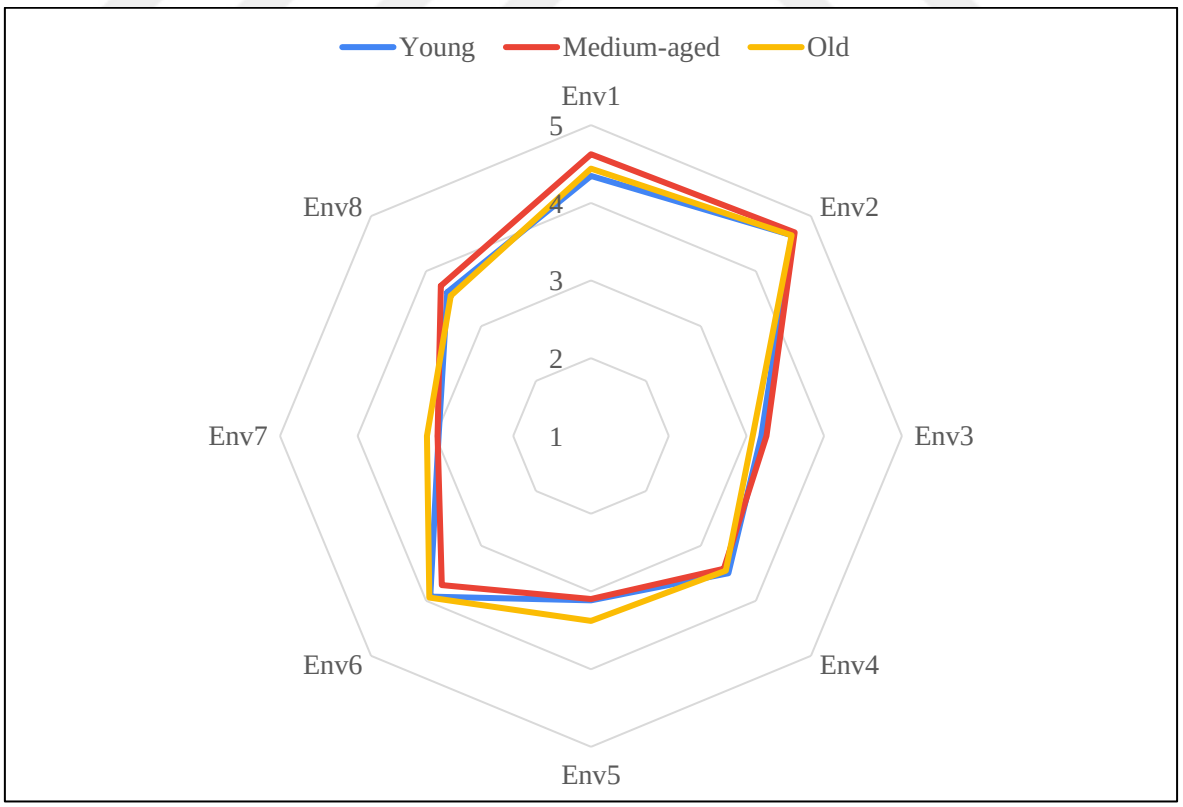

Figure E.3. Environmental change factors according to organization age.

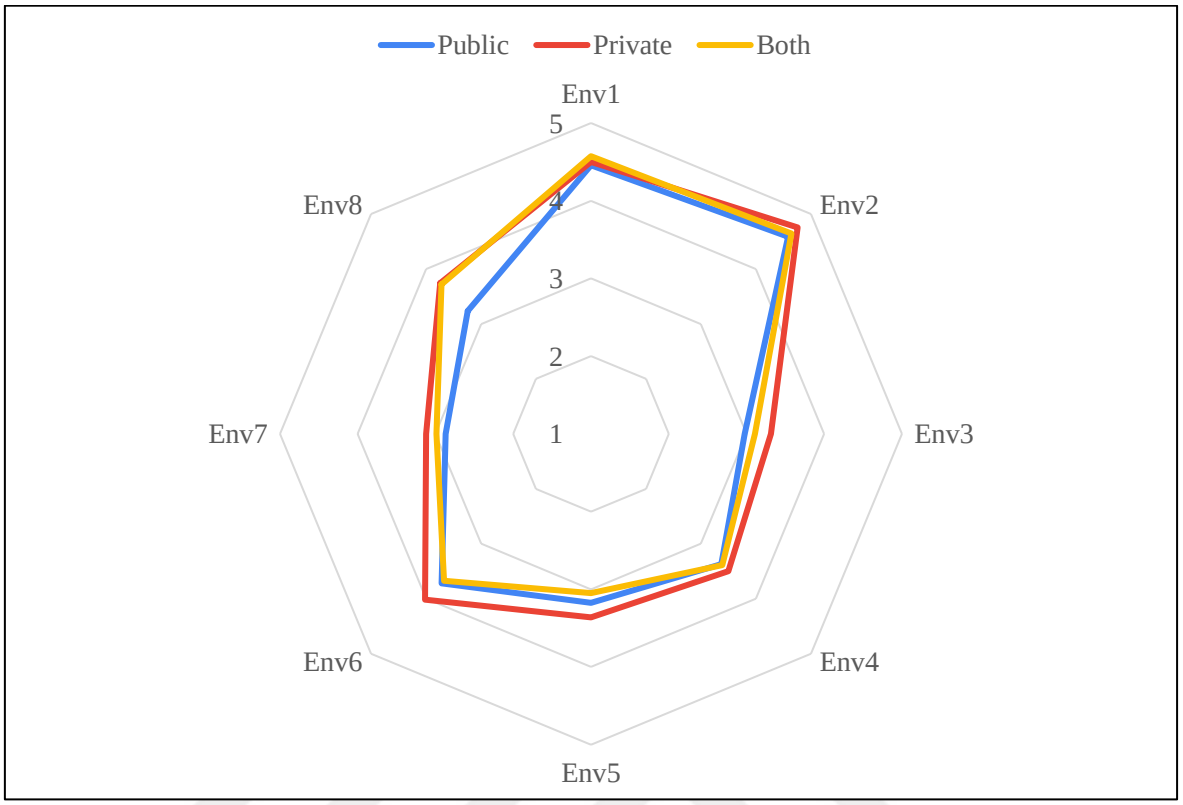

Figure E.4. Environmental change factors according to work sector.

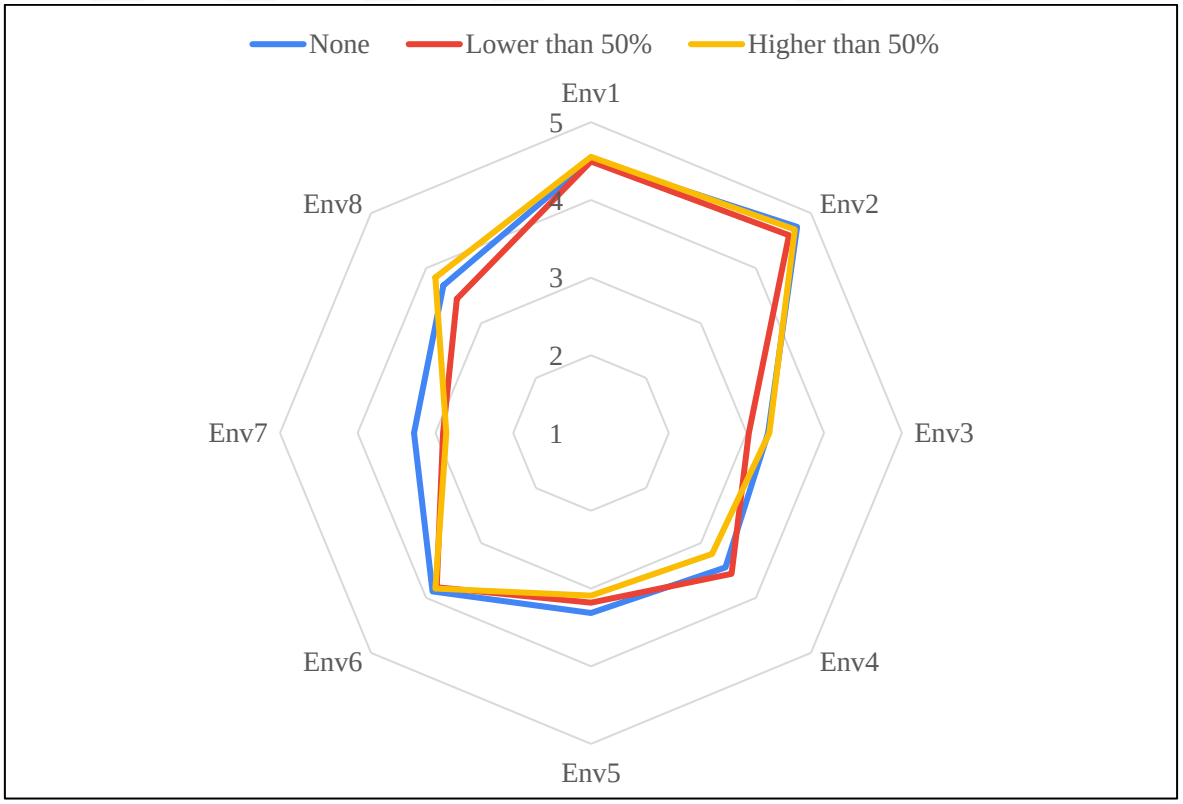

Figure E.5. Environmental change factors according to the percentage of international projects in the company.

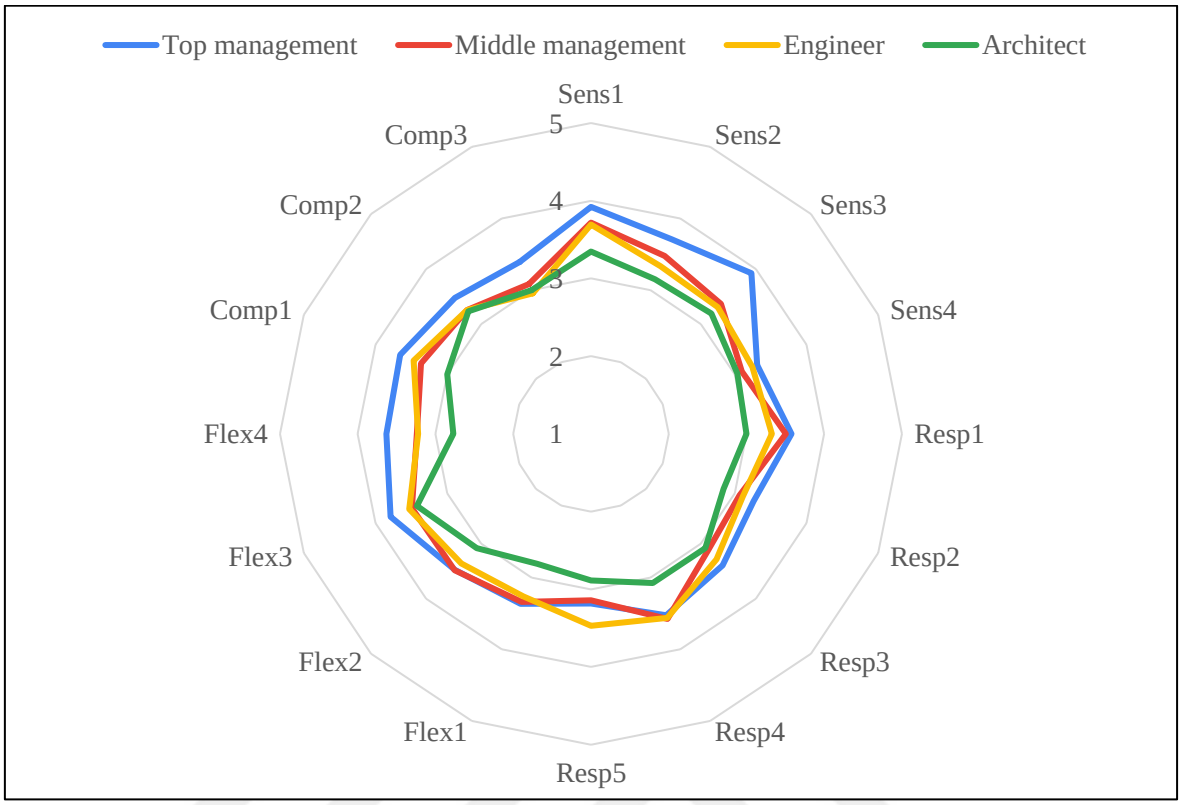

Figure E.6. Organizational agility items according to the role of the respondent.

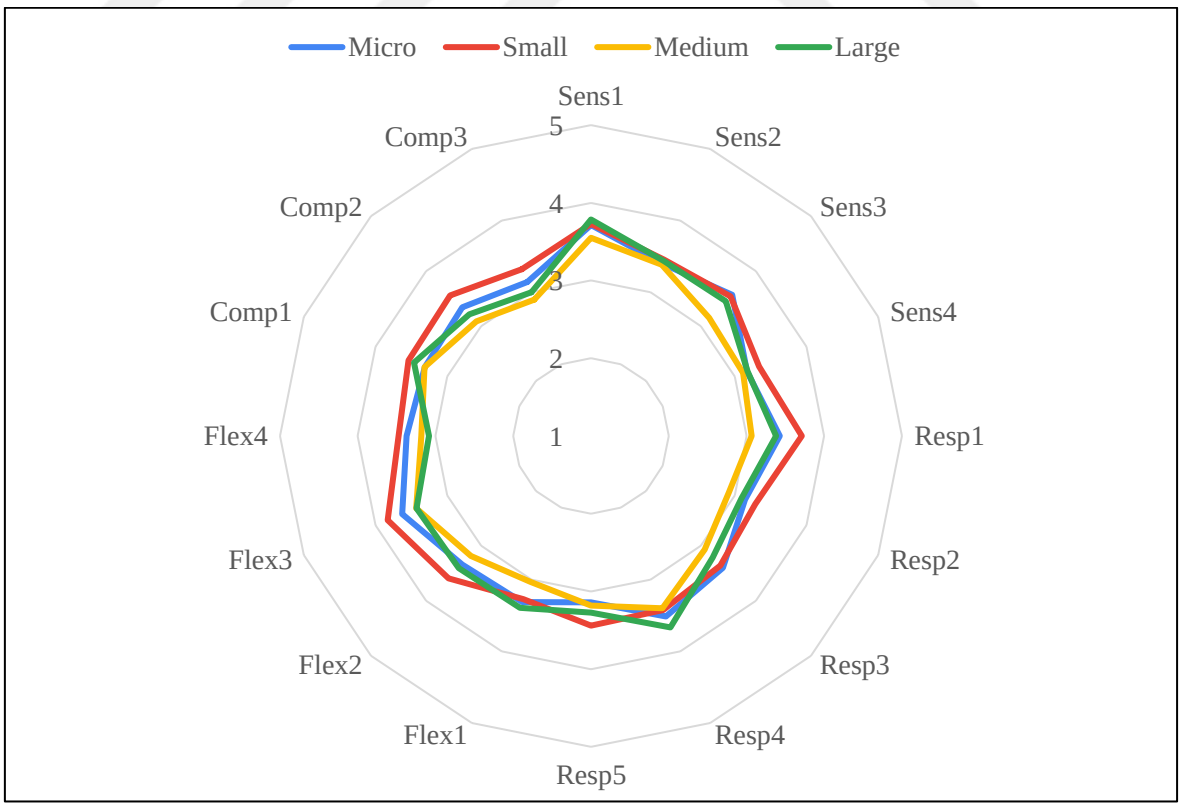

Figure E.7. Organizational agility items according to organization size.

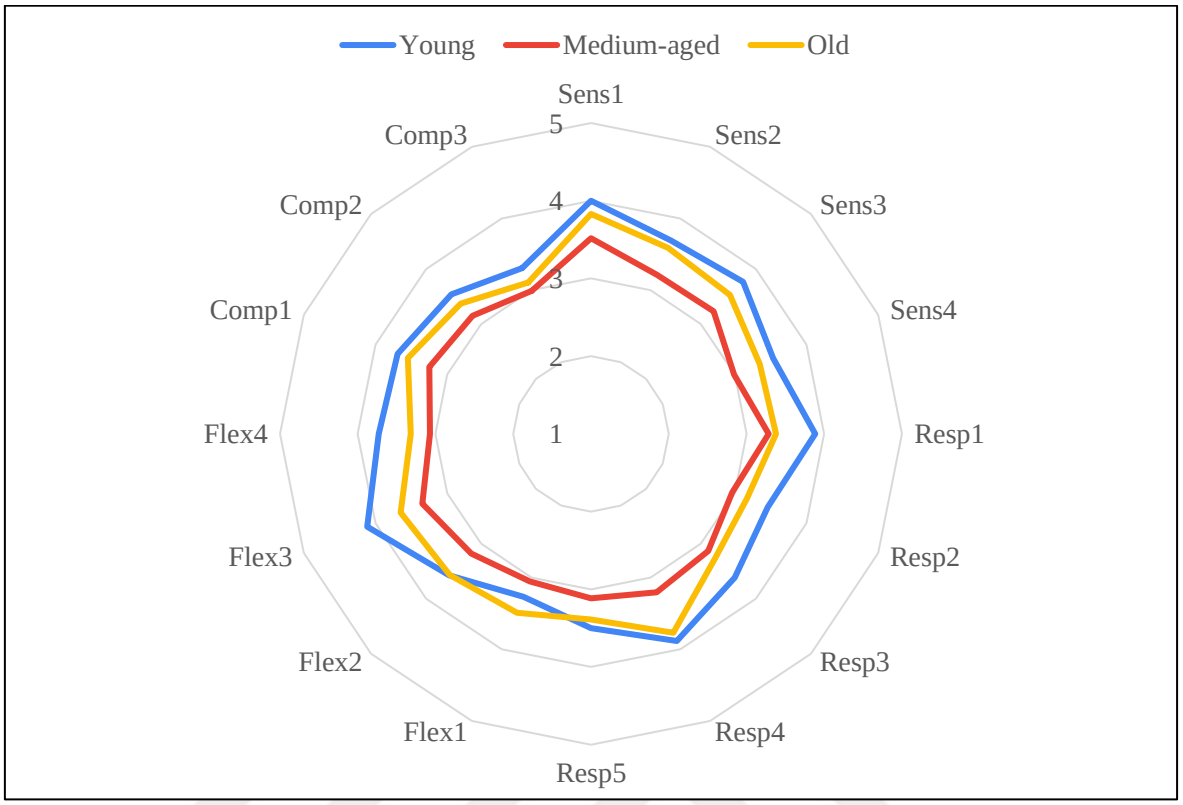

Figure E.8. Organizational agility items according to organization age.

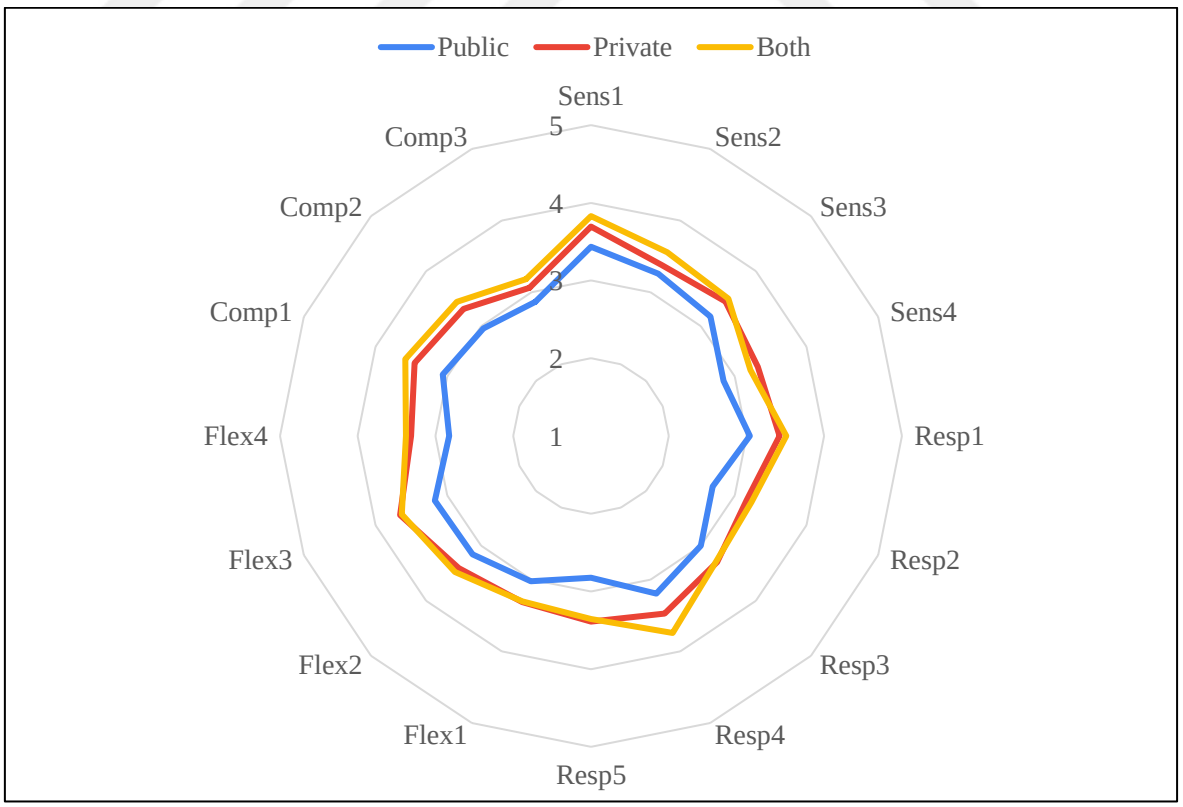

Figure E.9. Organizational agility items according to work sector.

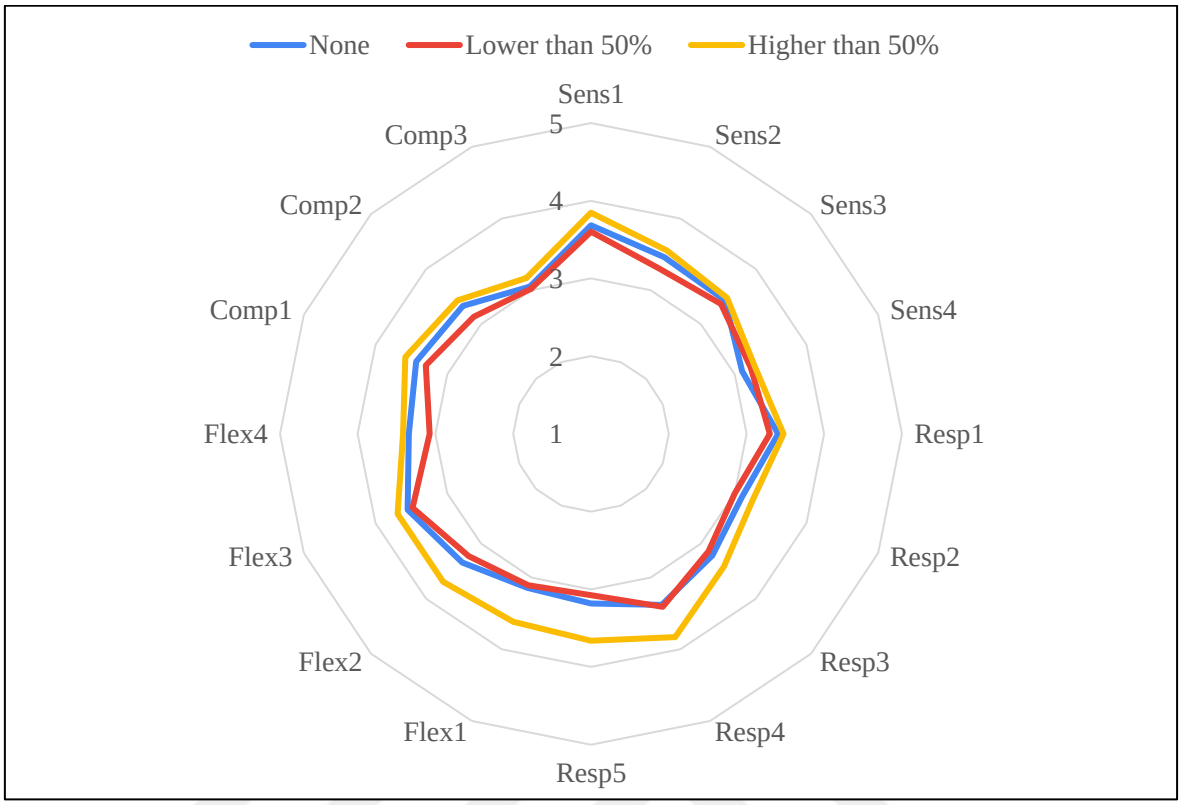

Figure E.10. Organizational agility items according to the percentage of international projects in the company.

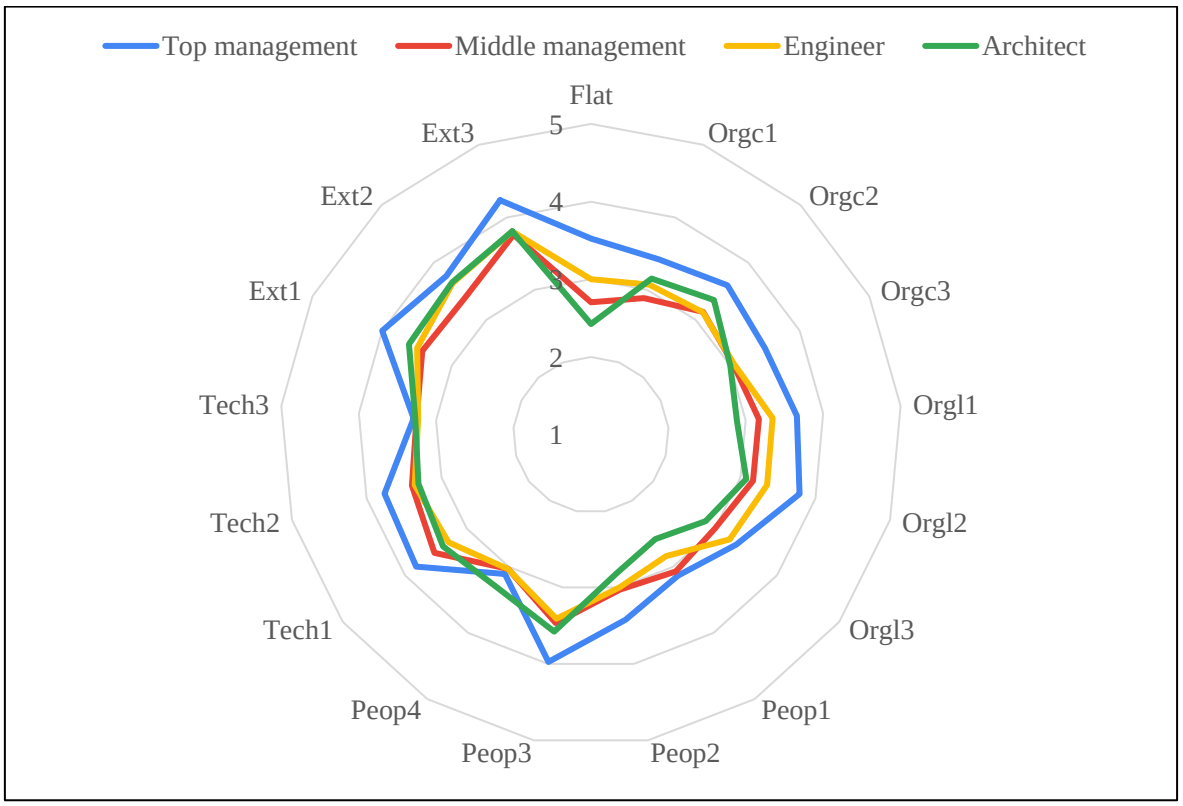

Figure E.11. Organizational agility enablers according to the role of the respondent.

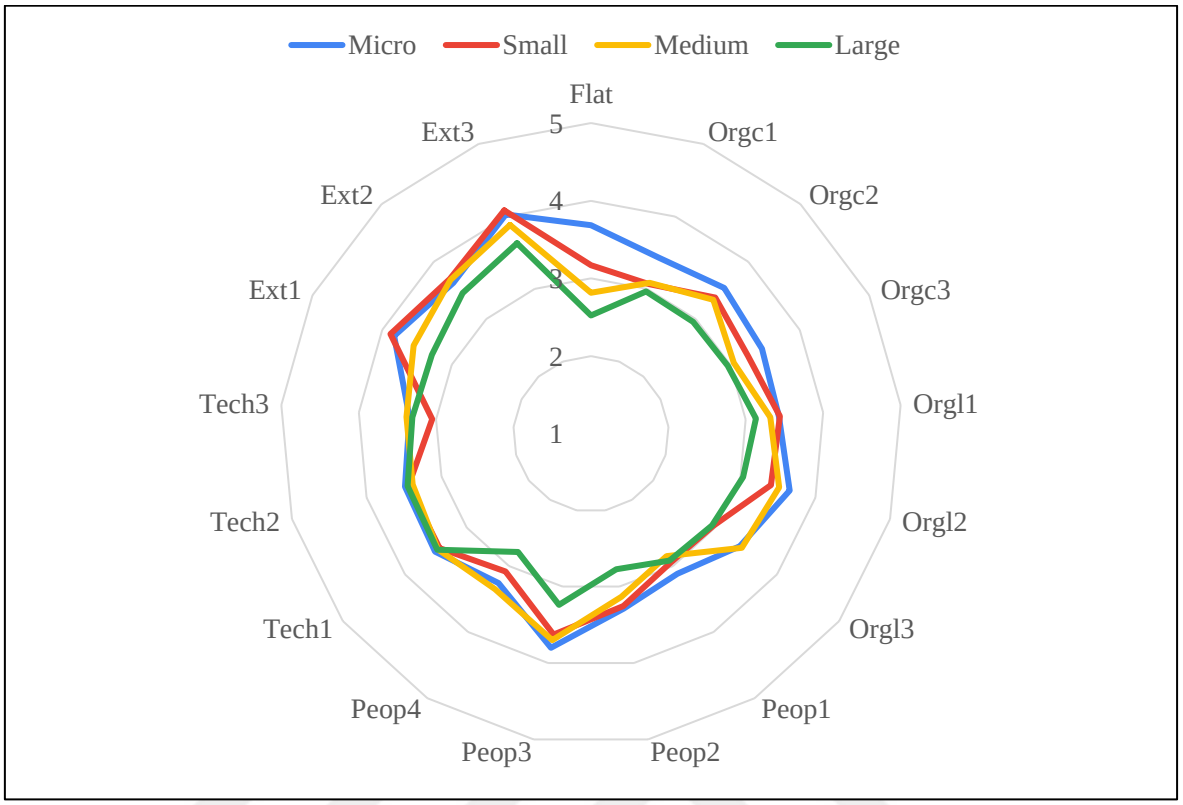

Figure E.12. Organizational agility enablers according to organization size.

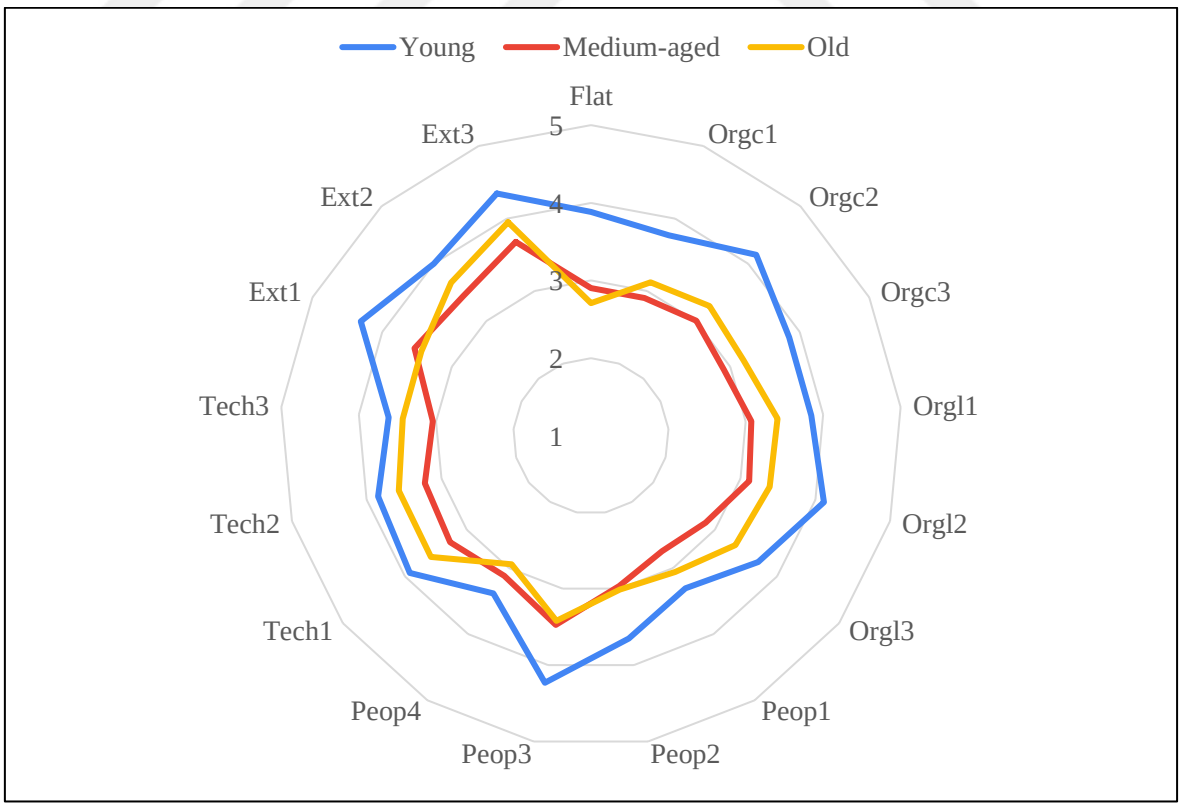

Figure E.13. Organizational agility enablers according to organization age.

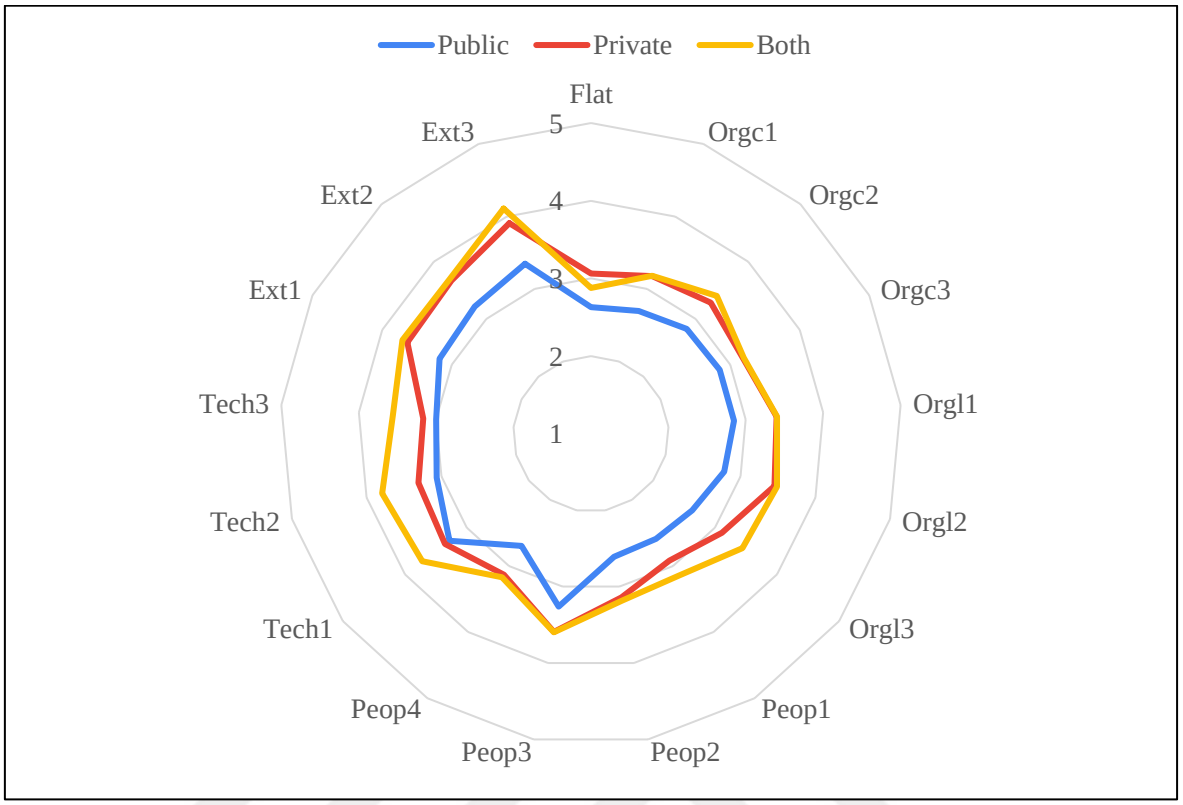

Figure E.14. Organizational agility enablers according to work sector.

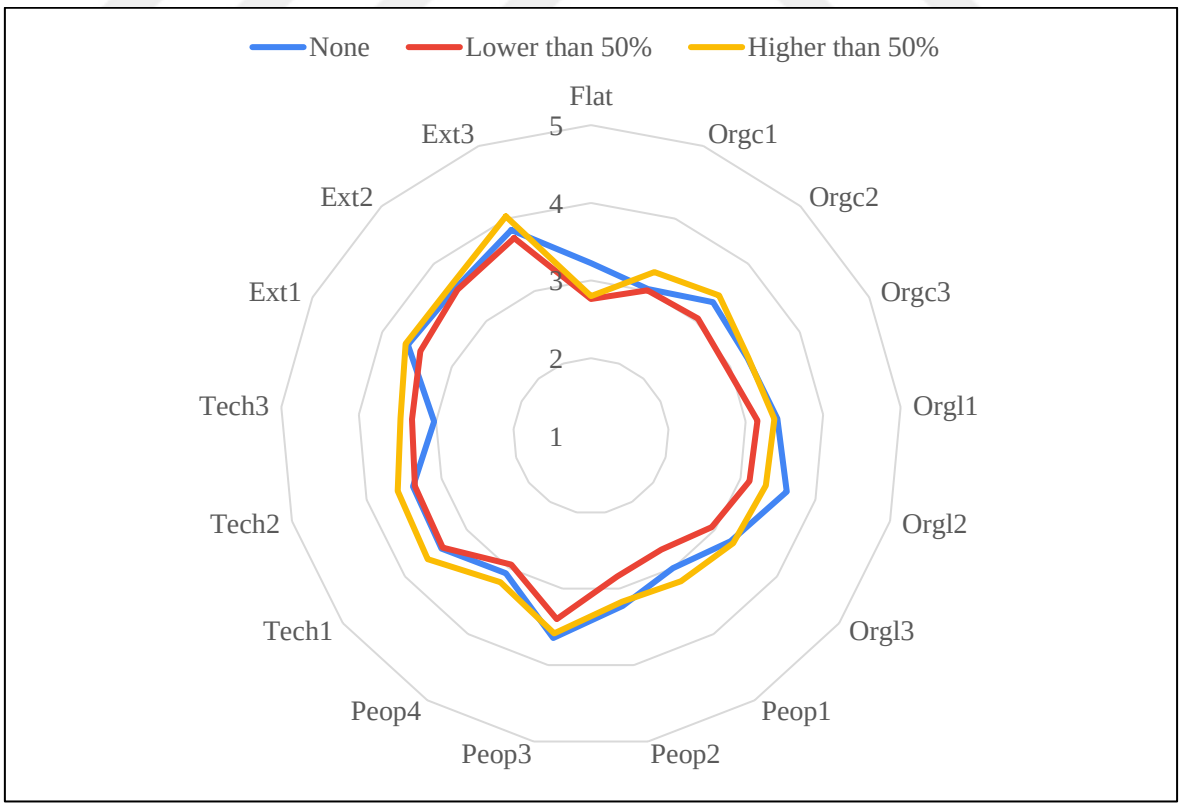

Figure E.15. Organizational agility enablers according to the percentage of international projects in the company.