INVESTIGATING ORGANIZATIONAL LEARNING IN THE TURKISH CONSTRUCTION COMPANIES

by
Murat Yelmen
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ABSTRACT

INVESTIGATING ORGANIZATIONAL LEARNING IN THE TURKISH CONSTRUCTION COMPANIES

In a rapidly changing and complex environment, construction industry companies are looking for many different ways to gain competitive advantage and to show a sustainable presence in the future. Organizational learning is a process which ables companies to adapt to changing conditions, gain an advantage over their competitors, and increase their productivity. Organizational learning is defined as the process by which organizations alter or adjust their mental models, rules, procedures, or knowledge in order to maintain or enhance performance. In this thesis study, organizational learning in construction companies in Turkey has been examined by considering the deficiencies of the studies in the literature. The main approach taken in this study is to develop a framework based on a comprehensive literature review covering the concept of organizational learning in the construction sector from a holistic perspective, and then to use empirical research to investigate this framework. The proposed framework consists of 6 main factors and 53 sub-factors obtained based on in-depth literature review and expert opinions. These items were evaluated by the employees of construction companies through a questionnaire survey where 136 participants responded and the collected data were analyzed with descriptive statistics and Structural Equation Modeling (SEM). As a result, it has been revealed that companies see client requirements as a significant driver for learning, and companies learn most from the experiences of other companies and by acquiring new employees. It has been concluded that while individual and organizational training is seen as the distinct enabler factor for learning, the ambiguous goals is perceived as the most obvious barrier. It has been determined that the most significant effect of organizational learning is the increase in productivity, both as an impact on corporate level and as a benefit on a project level.

ÖZET

TÜRKİYE'DEKİ İNŞAAT ŞİRKETLERİNDE ORGANİZASYONEL ÖĞRENMENİN İNCELENMESİ

Hızla değişen ve karmaşık bir ortamda inşaat sektörü şirketleri, rekabet avantajı elde etmek ve gelecekte sürdürülebilir bir varlık göstermek için birçok farklı yol aramaktadır. Örgütsel öğrenme, şirketlerin değişen koşullara uyum sağlamalarını, rakiplerine karşı avantaj sağlamalarını ve verimliliklerini artırmalarını sağlayan bir süreçtir. Örgütsel öğrenme, organizasyonların performansı korumak veya geliştirmek için zihinsel modellerini, kurallarını, prosedürlerini veya bilgilerini değiştirme veya uyumlama süreci olarak tanımlanır. Bu tez çalışmasında, literatürdeki çalışmaların eksiklikleri göz önünde bulundurularak Türkiye'deki inşaat şirketlerinde örgütsel öğrenme kavramı incelenmiştir. Bu çalışmada benimsenen temel yaklaşım, inşaat sektöründe örgütsel öğrenme kavramını kapsayan derinlemesine literatür taramasına dayalı bütünsel bir bakış açısıyla kavramsal bir çerçeve geliştirmek ve ardından bu çerçeveyi incelemek için deneysel araştırma yürütmektir. Sunulan çerçeve, derinlemesine literatür taraması ve uzman görüşlerine dayalı olarak elde edilen 6 ana faktör ve 53 alt faktörden oluşmaktadır. Bu 53 madde bir anket çalışması formatına dönüştürülmüş ve çalışmaya Türkiye'deki inşaat şirketlerinden 136 katılımcı yanıt vermiş ve toplanan veriler, betimleyici istatistikler ve yapısal eşitlik modellemesi (YEM) metodu kullanılarak analiz edilmiştir. Sonuç olarak, şirketlerin müşteri gereksinimlerini öğrenme için önemli bir itici güç olarak gördükleri ve şirketlerin en çok diğer şirketlerin deneyimlerinden ve yeni çalışanlar edinerek öğrendiği ortaya çıkmıştır. Bireysel ve örgütsel eğitim, öğrenme için belirgin bir kolaylaştırıcı faktör olarak görülürken, muğlak hedeflerin en belirgin engel olarak algılandığı sonucuna varılmıştır. Örgütsel öğrenmenin en önemli etkisinin ise hem kurumsal düzeyde bir etki hem de proje düzeyinde bir fayda olarak verimlilik artışı olduğu tespit edilmiştir.

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LIST OF SYMBOLS

α	Cronbach's Alpha
$\bar{c}$	Average inter-item covariance
$\bar{v}$	Average variance
$\chi 2$	Chi-square

LIST OF ABBREVIATIONS

AEC	Architecture, Engineering and Construction
AMOS	Analysis of Moment Structures
BDAS	Buildable Design Appraisal System
BIM	Building Information Modeling
CAS	Constructability Appraisal System
CEO	Chief Executive Officer
CPD	Continuous professional development
dof	Degree of Freedom
GLS	Generalized Least Squares
IT	Information Technology
KM	Knowledge Management
LISREL	Linear Structural Relations
LO	Learning Organization
ML	Maximum Likelihood
DSS	Decision Support Systems
NNFI	Non-Normed Fit Index
OL	Organizational Learning
OM	Organizational Memory
R&D	Research and Development
RMSEA	Root Mean Square Error of Approximation
CFI	Comparative Fit Index
SEM	Structural Equation Modeling
SPSS	Statistical Package for Social Science
TCA	Turkish Contractors Association
TLI	Tucker and Lewis index
UK	United Kingdom
ULS	Unweighted Least Squares
USD	United Stated Dollar
WLS	Weighted Least Squares
WTU	Workforce Training and Upgrading

1. INTRODUCTION

In a constantly changing and increasingly turbulent environment, companies are looking for many different ways to gain competitive advantage and are starting to pay more attention and invest in regarding topics. According to Drucker (1998), knowledge is the only viable source of competitive advantage. According to Edmondson and Moingeon (1998), organizational learning is one of the "intangible" resources of companies because it is very tough to imitate. The concept of organizational learning originally emerged from the work of Cyert and March (1963), and they used the theory of "Adaptive Learning" to define companies as anthropomorphic entities (Wong et al., 2012; Chan et al., 2005; Pawlowsky, 2001). Cyert and March (1963) stated that the learning of an organization is not different from the learning of individuals and they defined organizational learning as a mechanistic stimulus–response process. Consequently, an organization's remedial actions rely on memory of stimulus-response combinations (Cyert and March, 1963).

Based on the literature, it can be said that the main mechanism of competitive advantage and increasing productivity is organizational learning (Ahankoob et al., 2015). Organizations often pursue more than one project at the same time and have to rush from one project to another without fully learning from the previous one (Almaian and Qammaz, 2019). For this reason, organizations should approach the issue of organizational learning in a systematic way and they have to take active steps in this regard. The issue of organizational learning, which gained importance especially in the 1980s and 90s, continues to be relevant starting from the 1960s and causes many academics to conduct research on this subject. Organizational learning emerges as an important approach to how organizations are managed, and this approach has been influenced by many different disciplines such as psychology, sociology, economy, cybernetics, in the development of the process (Burnes et al., 2003; Garratt, 1995).

Although the concept of organizational learning has been covered and discussed a lot in the construction management literature (Bakar et al., 2016; Yang et al., 2014), it is stated that the desired level of organizational learning has not yet been reached in the construction industry, the reason for this is the lack of learning culture and tools to support organizational

learning (Tan et al., 2010; Ford et al., 2000). Knowledge is mostly not recorded and lost at the end of the projects, so companies cannot learn from their past experiences. A culture of learning and supportive solutions are required to reverse this trend, and construction companies should be able to transfer their knowledge at the organizational level rather than at the project level, and the accumulated knowledge should survive in a way that serves the company (Eken et al., 2020).

One of the biggest challenges construction company managers face is figuring out how to manage intellectual capital. The business environment encounters a new concept called knowledge era. Here, knowledge is the new power and fast learning has become a prerequisite strategy for success, but intellectual capital management remains an area that is still undervalued for construction companies. The management of know-how, know-what, know-why matters is different from finance or construction site management, and a serious emphasis on intellectual investments plays a critical role (Kululanga and McCaffer, 2001). The crucial and vital lessons that can be learned from retrospective studies of projects are lost due to the lack of an adequately structured framework. Although the construction industry has taken important steps to modernize the elements within itself, unnecessary recorded information loss is still one of the industry characters (Kululanga and Kuotcha, 2008).

The aim of this study is to examine the thoughts and perspectives of professionals working in the construction industry on organizational learning, and to analyze the factors affecting organizational learning in construction projects and organizations. The problem definition and statement, aim and objectives of the work, research methodology, study significance, scope and limitations, and organization of the study will be presented in summary as sub-titles of the introduction.

1.1. Research Gap

Although researchers on organizational learning have been conducting studies for decades, it has been repeatedly mentioned in the literature that there are deficiencies especially in the field of empirical research. Although there are theoretical researches on organizational learning in the construction sector, empirical studies examining the concept

from a wide framework and how construction companies can apply organizational learning more easily are not sufficient. Within the scope of this thesis, a comprehensive study will be conducted that examines and analyzes the approaches of the construction sector organizations in Turkey to the concept of organizational learning, the learning process and the factors affecting this process. Below are some points that mention the lack of especially empiricial researches in the studies on organizational learning in the literature.

Management researchers have begun to identify the inconsistency between organizational learning-related concepts in the literature and have mentioned the lack of sturdy theoretical but, more significantly, empirical foundation (Chan et al., 2004). Lipshitz et al. (2002) mentioned that the studies in the literature on organizational learning do not provide a more descriptive definition about the learning organization, and that there is not enough clarity about how to become a learning organization, and that the concept of organizational learning, like many other fields in social sciences, has become more complex and fuzzy with the number of observations and studies conducted.

Huysman (2000) has mentioned that there is no solid theoretical basis regarding the concept of learning organization as opposed to the popularity of the concept. This has supported researchers who previously argued that expanding the boundaries of studies on the concept plays a detrimental role in the coherence of the study. Little progress has been made in the literature on identifying key scales that will improve organizational learning, and this is mainly due to the lack of empirical studies in the field (Chan et al., 2004; Lahteenmaki et al., 2001).

Examining the literature on organizational learning (OL) in construction companies, it is clear that the structure of empirical research is relatively small compared to conceptual work (Kululanga et al., 2002; Garvin, 1993). One of the main reasons for this is the fact that learning skills and level is difficult to quantify, because it is mostly about tacit knowledge and improving an organization's cognition (Cook and Yanow, 1993). There are many theoretical research studies supporting that OL increases the competitive advantage in construction companies (Egbu et al., 2000). However, since this concept is difficult to observe, empirical research studies related to topic are limited (Dulaimi and Ling, 2003).

Much of the literature on learning organizations and organizational learning has focused on conceptual issues (Garvin, 1993), studied on philosophical and metaphorical definitions rather than empirical research (Calvert et al., 1994). A similar view is argued by Ulrich et al. (1993) that most of the research on the learning abilities of managers so far is “thought paper”, not empirical research.

Such conditions should take into account the context of the industries in which organizations operate. This is also one of the features that is often overlooked in research on learning organizations and organizational learning. For example, organizations in the construction industry have a number of features that distinguish them from other industries. Such characteristics may possibly influence the focus of their organizational learning orientation.

There is an equal bias towards qualitative research in the learning organization and in the organizational learning literature (Jashapara, 1995). This has resulted in a lack of quantitative research that could enrich courses with generalizations to compare organizational learning across organizations in various industries. A culture of “organizational learning for improvement” does not occur by accident, it is an organization's internal, deliberate actions that take in response to appropriate information and other stimuli from business and external business circles (Barlow and Jashapara, 1998). Despite significant academic and sectoral attention to concept of organizational learning (Styhre et al., 2004), the dispersal of organizational learning in construction industry has proven troubled (Orange et al., 1999) and as a result is insufficient compared to other industries (Chinowsky et al., 2007).

There is a bias in qualitative research on issues related to organizational learning (Jashapara, 1995). This is due to there is the illusion of organizations in many different industries learn in a similar way and that adequate quantitative research is not available. The concept of “learning for improvement” cannot occur spontaneously, it is a result of the actions of organizations to step and take positions for appropriate knowledge and stimuli from their internal and external environments (Kululanga et al., 2002).

1.2. Significance of the Study

The results of the study carried out can help the managers or employees of the construction organizations to create a broad framework about the concept of learning organization and help their companies and the industry to improve. As stated under the title of research gap, especially empirical studies on organizational learning are lacking. Within the scope of this study, the results of the survey conducted with construction company officials in Turkey contribute to the literature on factors related to organizational learning. With a good understanding of these factors and additions, future researchers can repeat or expand the work. From a wider perspective, with this study, sector employees or those who will start working in the sector can have a broad knowledge of the concept of organizational learning, and then they can improve their performance by giving more importance to this concept with their awareness.

1.3. Scope and Limitations

First of all, the concept that determines the scope and limits of the study is that the concept of organizational learning is a qualitative concept rather than a quantitative one. For this reason, only a questionnaire study was conducted to measure this concept quantitatively, and the results of this survey study are therefore based on the personal experiences and thoughts of the professionals working in the sector. Hodgkinson and Sparrow (2002) indicated that current paths to measuring knowledge to assess cognitive changes through questionnaires and verbal protocols fail to capture implicit or in other terms tacit knowledge. The conducted study consists of evaluating the points collected from the literature, while listing the critical success factors related to the concept of organizational learning, by means of a survey to professionals working in the construction industry in Turkey. Therefore, the results of the study and the opinions of the professionals are specific to the construction industry in Turkey, and factors in other countries may differ in this regard, and the results of the study may differ.

Another limitation of the study is that it is based on the analysis of professionals' current assessments of the subject only. It is not based in any way on a specific case study

and does not examine how companies' approaches to organizational learning change over a period of time.

1.4. Research Methodology

In the study, firstly, a comprehensive literature review was conducted. Organizational learning definitions, concepts related to the subject, relations between trend topics and the subject, and existing frameworks in the literature were reviewed. Secondly, a conceptual framework is presented based on these past studies. The model created within this framework includes the factors that drive the construction companies to organizational learning, learning resources, factors that act as enabler or barrier to the process, and finally, the impacts of the process at the corporate level and the benefits at the project level. Third, a survey study was prepared in order to measure the importance of the factors prepared in the scope of framework for the professionals of the construction industry. As an intermediate step, the survey was tested by five construction industry professionals and updates were made in the survey based on their feedback, these updates mostly aimed at making the questions and factors more understandable. Furthermore, different statistical models were examined and structural equation modelling (SEM) technique is selected and utilized as a research tool with the help of SPSS AMOS V26.0 software to test the validity of the proposed conceptual model and to test the hypotheses proposed based on relations among factors of organizational learning. Based on the statistical results, the outcomes are discussed and suggestions are made for future academic studies.

1.5. Aim and Objectives

The main purpose of this study is to examine the perspectives and opinions of the construction industry professionals in the Turkish construction industry about the current status and factors related to organizational learning. In order to do this, a comprehensive framework consisting of factors and indicators related to organizational learning was created based on a deep literature review. In the comprehensive framework created, the factors that drive companies to organizational learning, learning inputs, enablers, barriers, benefits at the project level resulting from learning, and impacts at the corporate level are examined.

As a result of the framework created, it is aimed to enlight the relationship between the construction companies in Turkey and the concept of organizational learning. In summary, the aims of this research are to identify the determinants and reveal the indicators of organizational learning practices, to develop an integrated framework for the topic, to investigate the interrelationships between the factors affecting organizational learning practices in construction projects with a special focus on the Turkish construction industry, and to see their effects on construction companies and projects.

1.6. Organization of the Study

This thesis study consists of six main chapters in total. In Chapter 1, introductory information about the subject was given under the Research Gap, Significance of the Study, Scope and Limitations, Research Methodology, and Aim and Objectives titles. Chapter 2 covers a detailed literature review on the topic and a review of relevant concepts and frameworks. Chapter 3 describes the details of the methodologies used for the study carried out. Chapter 4 consists of the analysis details and descriptive statistics. Chapter 5 includes outputs and findings obtained as a result of the study. In addition, the results are compared with the literature and discussed in this section. In the last part, Chapter 6, the thesis study is summarized, recommendations and limitations indicated, and eventual suggestions that may be useful for future academic studies are made.

2. RESEARCH BACKGROUND ON ORGANIZATIONAL LEARNING

2.1. Organizational Learning

In the last century, the importance of organizational learning and discussions on this topic have developed and spread widely (Burnes et al., 2003). Throughout the 1990s, this discussion continued under the main headings of individual vs organizational, single loop vs double loop, cognition versus behaviour. However, Easterby-Smith et al. (2000) stated that at the third International Organizational Learning Conference, many new topics such as strategic and international learning, knowledge management, practice, policy, ethics committees and measurement of organizational learning were started to brought up.

The topic of why some organizations are more successful than others has been one of the most popular research topics. Despite its recent popularity, organizational learning is not actually a new concept, Argyris has been publishing on the subject for nearly 40 years. But there is no doubt about organizational learning that this topic has gained popularity especially in the 1990s. For example, Senge's book on learning organizations, The Fifth Discipline, written in 1990, has sold more than 650,000 copies. The number of academic articles on the learning organization in 1993 is higher than the number written in all of the 1980s. However, this does not mean that the topic lost its popularity towards the end of the 1990s, on the contrary, it is increasing in popularity and even the learning rates of organizations and individuals are seen as the only way to gain sustainable competitive advantage. Although such strong statements cause corporate executives to attach more importance to this issue, there are actually two main reasons why they give their full attention to this issue: the speed of change and the competitive threat posed by globalization.

It is an undeniable fact that in order for organizations to maintain their competitive advantage, they must adapt to the complex environment at a rapid pace which has increased more than ever before and. It is essential for organizations to adapt and constantly update themselves to social and economic changes, rapid developments in technology, situations where customers and suppliers are both competitors and alliances, and changes such as

quality more than number, service more than product. Companies that want to keep up with the change and development in this environment should acquire knowledge, create and benefit from it as much as possible, this is essential for being able to compete in the market.

Since Organization Science began publishing in 1991, the main topic has been organizational learning, which Cohen and Sproull (1991) edited the journal which was in honor of James G. March and included his papers. Later, journal also took an interest in the subject of knowledge as the title of organizational learning and included publications in this field. Organizational science has also published publications in the fields of leadership, knowledge, and organization with the edits of Grandori and Kogut (2002). Organizational science is well positioned to publish research on organizational learning (OL). OL is a multidisciplinary topic by nature and organizational learning includes developments in many different fields, such as organizational behavior and theory, cognitive and social psychology, sociology, economics, information systems, management and engineering. This multidisciplinary field makes organizational learning a perfect match for Organization Science, whose purpose is to build bridges between organizations in different fields.

Although the concept of organizational learning is defined differently by many researchers, the fundamental definition accepted by most is the change in knowledge and organization which is depending on the experience organizations have gained. However, the question of change in what naturally arises here as well. Although researchers have debated for many years about whether organizational learning leads to cognitive or behavioral change in organizations, this debate has not lasted until today. It is generally accepted among researchers that organizational learning is the change that occurs in the knowledge of the organization as a function of the experience of companies. This knowledge can be explicit or tacit, cognitive or behavioral, and difficult to articulate. Knowledge can occur in different forms and can seen in different components of organizations such as individuals, routines, and transactive memory systems.

Although the subject of organizational learning is accepted as the change that occurs as a function of the experiences of the organizations in the literature, there are many different definitions by many researchers in the literature. Table 2.1 shows how different researchers in the literature define the concept of organizational learning.

Table 2.1. Definitions of organizational learning.

Reference	Organizational Learning Definition
(Argote and Miron-Spektor, 2001)	"[…] is a change in the organization that occurs as the organization acquires experience."
(Argote, 2013)	"[...] a change in the organization's knowledge that occurs as a function of experience."
(Argyris and Schon, 1978)	"[...] the detection and correction of error."
(Argyris, 1977)	"[...] the process of detecting and correcting error. Error is for our purposes any feature of knowledge or knowing that inhibits learning."
(Berends et al., 2003)	"[...] is the effective way of making use of past experience and adapting to environmental changes."
(Chiva et al., 2014)	"[…] the process through which organizations change or modify their mental models, rules, processes or knowledge, maintaining or improving their performance."
(Cyert and March, 1963)	"[...] a mechanistic stimulus–response process."
(Duncan and Weiss, 1979)	"[...] the process by which organisation members develop knowledge about action outcome relationships and the effect of the environment on these relationships, which leads to growth and change of organisational knowledge."
(Fiol and Lyles, 1985)	"[...] change in the organization's knowledge that occurs as a function of experience."
(Fiol and Lyles, 1985)	"[...] the process of improving actions through better knowledge and understanding."
(Garvin, 1993)	"[...] an organization skilled at creating, acquiring, and transferring knowledge, and at modifying its behaviour to reflect new knowledge and insights."
(Klimecki and Lassleben, 1998)	"[...] the changes in organizational knowledge that are induced by information processing and that enable an organization to find new ways of surviving and succeeding in new situations."
(Kogut and Zander, 1992)	"[...] is the systematic promotion of a learning culture within an organization such that employees at all levels, individually and collectively, continually increase their capacity to improve their level of performance."
(Kululanga et al., 1999)	"[...] the systematic promotion of a learning culture within an organization such that employees at all levels, individually and collectively, continually increase their capacity to improve their level of performance."
(Levitt and March, 1988)	"[...] learning by encoding inferences from history into routines that guide behaviour."
(Lopez et al., 2005)	"[...] a dynamic process of creation, acquisition and integration of knowledge aimed at the development of resources and capabilities that contribute to organizational performance."
(Nevis et al., 1995)	"[...] the capacity or process within an organization to maintain or improve performance based on its experience."
(Nonaka et al., 2001)	"[...] the interaction among individual learning which create knowledge in an organisation."
(Pheng et al., 2016)	"[...] is about acquiring knowledge (Curado, 2006; Huber, 1991) and putting this knowledge to future uses, for the purpose of solving problems or to perform better through lessons learned."
(Schilling and Kluge, 2009)	"[...] an organizationally regulated collective learning process in which individual and group-based learning experiences concerning the improvement of organizational performance and/or goals are transferred into organizational routines, processes and structures, which in turn affect the future learning activities of the organization's members."
(Stata, 1989)	"[...] getting everyone in the organisation to accept change."

2.2. Knowledge Pyramid

The links between data, information, knowledge, and wisdom are represented by a pyramid; each level's building block signifies a step up to a higher level: first, data, then information, then knowledge, then wisdom which can be seen in the Figure 2.1. According to Wallace (2007), the starting point of the pyramid is not clear and the concepts of data, information, knowledge, and sometimes wisdom have been used hierarchically for years in the language of information science. According to Frické (2018), historically, the paths to the construction of the pyramid are perhaps best followed by essential points in the "traditional sources" of Adler (1986), Ackoff (1989) and Zeleny (1987). Each stage adds value to the basic data and provides answers to various inquiries regarding it. We get more knowledge and insights from our data when we add meaning and context, which enables us to produce better and data-based decisions.

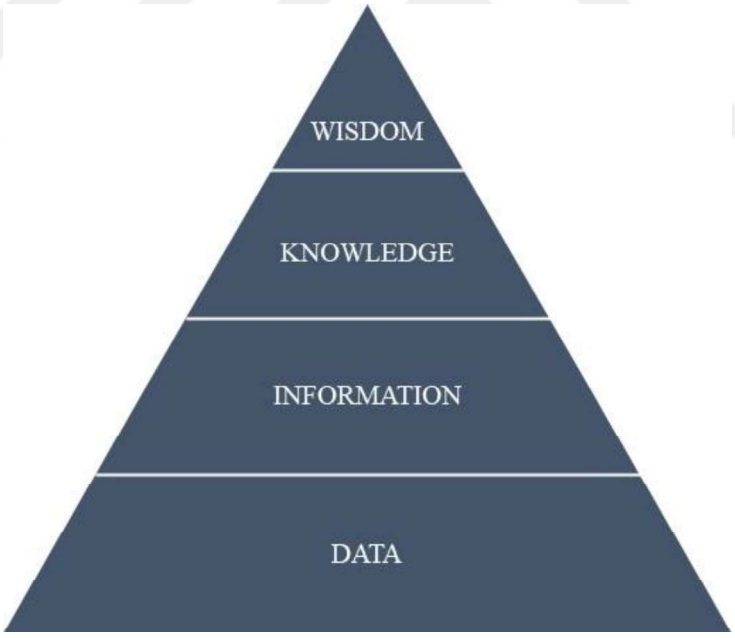

Figure 2.1. Data, Information, Knowledge, Wisdom Pyramid

Data is a grouping of facts in their unprocessed or raw form, such numbers or letters. However, data might be meaningless without context. The pyramid's subsequent construction block is information. This is the data that has been further processed to remove inaccuracies and make it simpler to measure, display, and analyze for a particular purpose.

Information becomes knowledge when it is understood how to be utilized to attain objectives rather than merely being seen as a summary of facts that have been gathered. Businesses frequently enjoy an advantage over their rivals thanks to this knowledge. Answers to questions like “why do something” and “what is best” are necessary in order to reach wisdom, which is at the summit of the hierarchy. In other words, wisdom is knowledge that is put to use.

2.3. Knowledge Management

Knowledge is a difficult concept to define and measure, especially at the organizational level. Some researchers measure organizational learning by measuring the cognition of company members. Some researchers approach to the issue by examining changes in knowledge, changes in practice and routines, and identifying the source of these changes as organizational learning. Another approach is to measure the characteristic changes in the performance of companies, for example consistency or speed, it is possible to define them as a measure of organizational learning of acquired or created knowledge.

Knowledge management as a close and parallel research stream with the organization learning which is the systematic process to increase productivity and effectiveness of organizational members through systematic acquisition, organization and verbal trade of knowledge. Organizational learning in knowledge management stands out as an important element that provides a continuous knowledge development in order to create and benefit from new information. The processes of knowledge creation, retention, and transfer are a complementary intersection of organizational learning and management.

2.4. Organizational Learning Process

Four main phase structures related to organizational learning process were defined by Huber (1991) and then the format has been extensively studied and discussed in the literature. These structures are knowledge acquisition, information distribution, information interpretation, and organizational memory as seen in Figure 2.2. The concept of knowledge acquisition in the literature has a large volume and includes many different layers. Within the scope of this study, the concept of organizational knowledge acquisition is examined

under 5 main sub-processes: (1) existing knowledge at the birth of the organization, (2) knowledge gained from experience, (3) learning by watching other organizations, (4) knowledge that the units have but not the whole organization, and (5) recognizing and exploring knowledge in the organization's environment and performance. A review of the relevant literature reveals that learning from experience has a much larger portion than other sources. In addition, the loss of organizational knowledge due to the lack of a collaborative and integrated work culture has been expressed by many different researchers.

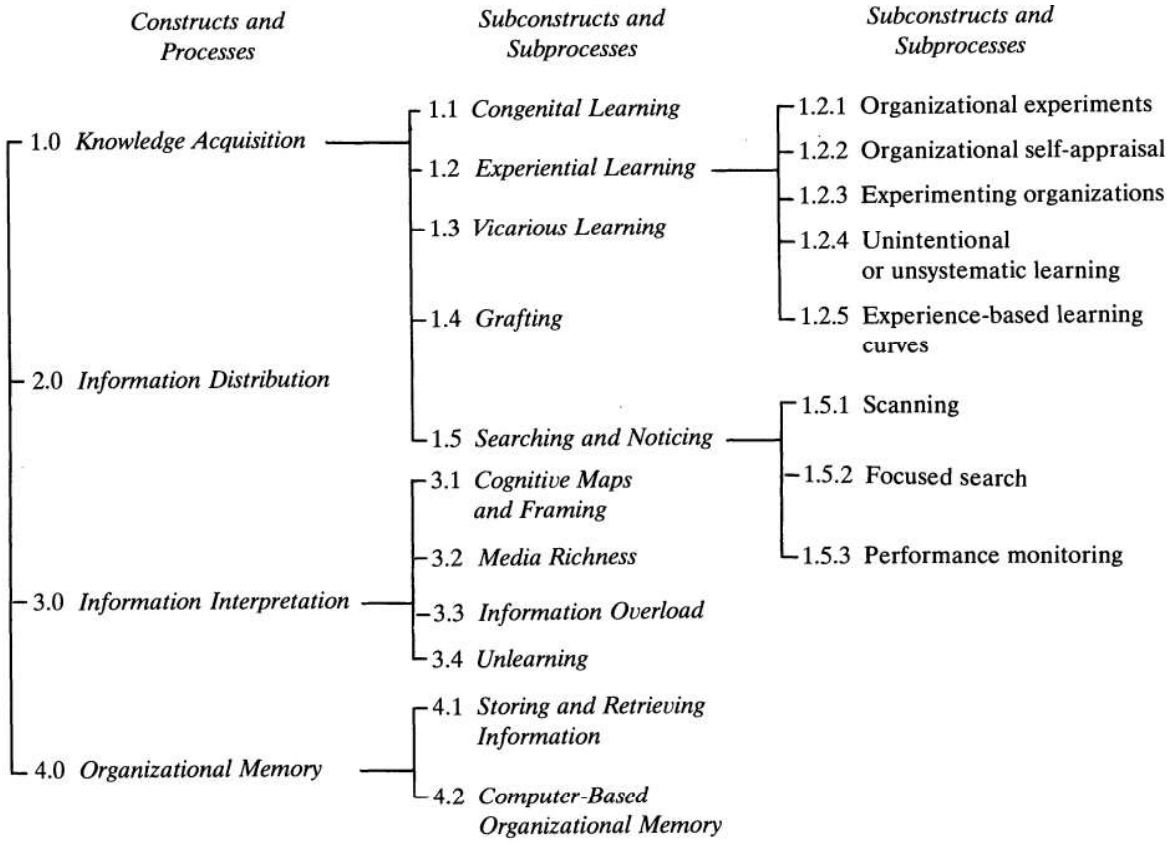

Figure 2.2. Constructs and processes associated with organizational learning (Huber, 1991).

2.4.1. Knowledge Acquisition

Many formal organizational activities aim at the acquisition of knowledge. For example, customer surveys, research and development activities, performance evaluations, analysis of competitors' products or services. In addition, many informal behaviors are aimed at acquiring information, such as following business publications, listening to news

regularly. As can be seen in Figure 2.1, knowledge acquisition consists of five sub-processes, (1) congenital learning, (2) experiential learning, (3) vicarious learning, (4) grafting, and (5) searching.

2.4.2. Knowledge Distribution

Knowledge distribution is one of the main factors that determine both the scope of organizational learning and whether it will occur. Just as the shipping departments in companies learn about the scarcity of any product by comparing their own figures with the figures in the sales department, organizations learns also when the information in different units of the organization complements each other. Companies often do not know exactly what their units know, so they cannot demonstrate a common learning process. However, many organizations have coded information that is routinely stored, called hard information, but they do not have control over which information to access from which source or department, and how to interpret it. Consequently, the more an information is spread within the company, the more it is accessible to different units and those who need it, and thus the knowledge acquisition process proceeds more successfully.

2.4.3. Knowledge Interpretation

One might infer that the more interpretations vary in an organization, the more learning will take place because such developments change the organization's potential behavior, and this is the basic definition of learning. In addition, if other units know how different units interpret different topics, they will complete each other's interpretations and achieve a more successful learning process. Each unit's interpretation of each piece of information may differ, and a common deduction can be drawn from this distribution as a result of the share and discussion, which is more accurate or may be more beneficial to the company.

2.4.4. Organizational Memory

Organizational memory emerges as an asset of companies as the last step of these processes, and this asset is invisible like other assets and cannot be measured by numerical means. In organizations, this memory can be observed based on the behavior of individuals,

routines, rules and organizational transferred memory. Everyday experience and some research have made it clear that human contributions are weaker than satisfying organizational memory (Huber, 1991). The organizational memory problem is caused by more human factors than might be expected: (1) personnel turnover causes a great loss of organizational memory, (2) keeping information that may be useful in the future to oneself leads to the loss of a lot of information without being recorded, and (3) organizational members often retain information or they don't know where it is.

2.5. Organizational Learning in Construction Industry

Many problems arise due to the lack of information sharing and knowledge management in the construction industry: budget overruns, inability to comply with timelines, inability to meet end user requests. The industry is criticized by many researchers and practitioners for not being able to apply the newly created knowledge effectively and not being innovative enough.

Companies with project-based activities differ from companies with routine-based activities, these differences can be seen, for example, in the difference between organizational learning practices of organizations in the manufacturing sector and organizations in the construction sector. Implementing organizational learning in the construction industry is somewhat difficult because the construction industry is project-based, contains discontinuities, units are independent, includes self-activities. Many points such as personnel flow, materials, information from project to project differ significantly from each other. Therefore, it is very difficult to create a routine and therefore it is not possible to easily transfer and apply the knowledge gained from the flow from one project to another. Organizations in the construction industry often carry out multiple projects at the same time and most of the time jump to the next project without learning from the problems in the previous project. For this reason, quality problems and cost overruns are frequently observed due to the repetition of the same problem in different projects.

The colloborative working style in the construction sector is theoretically parallel to the definition of “co-configuration” and “knotworking” put forward by Engeström et al. (1999) based on the studies of Victor and Boynton (1998). The concept of co-configuration

is the collective effort of more than one organization to meet the common need of a customer or customers and create an adaptive production process. Many parties start together in configuration to share information, learn from each other, and develop the final product. The important thing is the concept of the 'knot' mentioned here, that these temporary disjointed partners come together for the sake of a common "object" of activities. It could be a product or a service, and then the knot is untied when the task is complete.

In fact, the construction industry plays a very active role in learning and incorporating different management concepts such as lean management, just-in-time principles and value engineering. According to previous studies (Demirkesen et al., 2020; Demirkesen, 2020; Kim, 2019; Locatelli et al., 2013; Mohan and Iyer, 2005), the main advantages of implementing Lean principles in the construction industry include cost reductions, time savings, increased productivity, better quality, improved customer relations, reduced rework, less waste, less inventory, enhanced worksite safety, fewer project variations, and increased worker motivation. The challenge that major construction companies constantly face is first the fragmented nature of the industry, which results in poor communication and ineffective coordination. Secondly, because each project is unique, it causes the knowledge gained in one project to not be easily transferred to the new project. Third, construction projects are often complex and comparatively long-term projects, which makes them even more challenging. Although construction businesses are often seen as not interested in knowledge-based industries, the shift to a learning organizational culture has gained attention in recent years (Chinowsky et al., 2007). He also added that the main driving force behind implementing a learning organization is the desire to remain competitive in the new information age through the provision of knowledge-based solutions that better match customers' expectations. The way forward for construction companies is to play an active role and promote their organizational policies, procedures and practices that explore and use knowledge generation to foster a sustainable learning process and continuity (Kululanga et al., 2001).

2.6. Organizational Learning and Related Concepts

2.6.1. Individual Learning versus Organizational Learning

It is recognized by researchers that there are significant differences between individual and organizational learning. Although individual learning is perceived as more important to organizations, organizational learning is not simply the sum of the learning of the members of the organization. Organizations, unlike individuals, not only influence their members, but also pass on what they have learned through norms and history (Fiol and Lyles, 1985; Lawrence and Dyer, 1983; Martin, 1982; Mitroff and Kilmann, 1976). Hedberg (1981) stated that although organizational learning takes place through individuals, this does not mean that the sum of individuals' learning is called organizational learning. Organizations do not have brains, but they do have cognitive systems and memories. Just like individuals, they develop their own personalities, have personal habits, and beliefs. They also develop worldview and ideology. Employees come and go, leaders change, but organizations retain memories, specific behaviors, mental maps, norms, and values over time. Learning improves organizational understanding and interpretation of organizations and enables them to build strategies that will survive. This enables associations, cognitive systems and memory to be developed and shared among members.

Although the knowledge is kept by individuals, the knowledge also expressed through the regulations within the social committee in the organization. If knowledge was only at the individual level, companies would only change with the employee turnover. However it is certain that hiring new employees does not mean that the company's skills change, but what a company can do and achieve is related to how employees comply with the principles of the organization and who contributes how much to organization.

2.6.2. Routines

Organizations learn by inferring from history, encoding and then routing them. In this context, on organizational learning, how organizations learn from direct experience, how they learn from the experiences of others, and how they create conceptual frameworks or paradigms by interpreting the experience are examined.

According to Levitt and March (1988), organizational learning is based on three main classical observations based on behavioral studies on organizations. The first of these is that behavior in organizations depends on routines. The second observation is that the actions of organizations are dependent on history and they form a link to the future by interpreting the past and making it routine. The third observation is that organizations are goal-oriented and their behavior depends on the relationship between the outcomes they observe and what they want the outcomes to be. As a general term, routine includes funds, rules, procedures, conventions, stages and technologies. It also includes structures of belief, framework, paradigm, code, culture, knowledge.

2.6.3. Archetypes of Organizational Learning

According to Argyris (1977), the differences in organizational learning styles exhibited by organizations to increase performance is the most discussed topic in the literature. It can also be seen in Table 2.2 that organizations list different organizational learning styles mapped as different archetypes. On the one hand, there is a simpler approach, where improvement is aimed at solving organizational problems and the focus is crystal clear. Another learning archetype can be defined as the type of learning that does not focus on what is seen as much as the other, and investigates the underlying cause of what is seen. Here, it is aimed to go beyond the seen solutions to organizational problems, to discover other underlying causes and to provide remote developments for the future. In order to achieve these remote developments, it is necessary to focus on the fundamentals of the organization. Although each couple uses different organizational learning words, the distinction is made. Consequently, the contrast in Table 2.2 is useful for recognizing differences in terminology used to describe the same idea of learning (Kululanga et al., 2001).

According to Kululanga et al. (2001) “Dimensions that contribute to learning” and “Factors that set the condition for generetive learning” are the two conditions that must be met for organizational learning to be effective. At both the individual and institutional level, learning dimensions describe the many ways that learning can take place. The conditions

under which each learning dimension is applied define the effective distribution of that dimension (Kululanga et al., 2001).

Table 2.2. Characteristics of the two main archetypes of organizational learning (Kululanga et al., 2001).

Addresses symptoms of performance problems of companies	**Addresses root causes of performance problems of companies**
Single-loop	Double-loop
Adaptive	Generative
Operational	Conceptual
Superficial	Substantial
Symptomatic	Systemic
Rules	Insights
Lower level	Higher level
Tactical	Strategic

2.6.4. Tacit Knowledge vs Explicit Knowledge

The dynamic knowledge generation process is highlighted by researchers as a vital component of OL (Cheng et al., 2014; Loermans, 2002; Real et al., 2014). In conclusion, the idea of organizational knowledge production, which sees OL as a dynamic process of implicit and explicit knowledge processes, is analyzed by Nonaka (1994). In this section, his work, the concepts of implicit and explicit knowledge, the differences of the concepts and what it means for organizations are briefly summarized. While explicit knowledge can be expressed, documented and communicated using symbols or language (for example, in documents), tacit knowledge is deeply embedded in the “individual's attachment to a particular environment” (Nonaka, 1991). Technical abilities and mental models that “deeply influence how we see the world around us” are examples of tacit knowledge (Nonaka, 1991).

The four stages of organizational knowledge production are shown as a repeating spiral (Basten and Haamann, 2018; Nonaka and Konno, 1998; Nonaka, 1994, 1991) and the interaction of these steps within the limits of implicit and explicit knowledge is shown in Figure 2.3. Individuals share their tacit knowledge through socialization (for example, a new member of an organization learn by tracking and copying the experienced ones).

Organizational knowledge development is constrained as knowledge is rarely articulated and difficult to apply across the company.

The translation and representation of tacit knowledge into understandable forms that can be understood by others is what externalization requires (Nonaka and Konno, 1998). For this process, techniques of transferring thoughts or pictures as words, concepts, figurative language (such as metaphors, analogies) and visuals are required (Nonaka and Konno, 1998). Externalization requires the formalization of highly personalized or specialized professional knowledge. Reconsolidation, classification, or classification of explicit information held by various individuals transforms explicit knowledge into more complex and explicit knowledge. Internal information of a group can be combined with data from other sources. In general, the combination entails the dissemination of information among members of the organization, such as meetings or computers. Internalization is defined as "the conversion of explicit knowledge into the organization's tacit knowledge" (Nonaka and Konno, 1998). To increase their tacit knowledge, people receive explicit information about their profession (for example, by looking at process documentation). They expand and reinterpret their tacit knowledge as recorded and verbalized experiences help assimilate knowledge (Basten and Haamann, 2018).

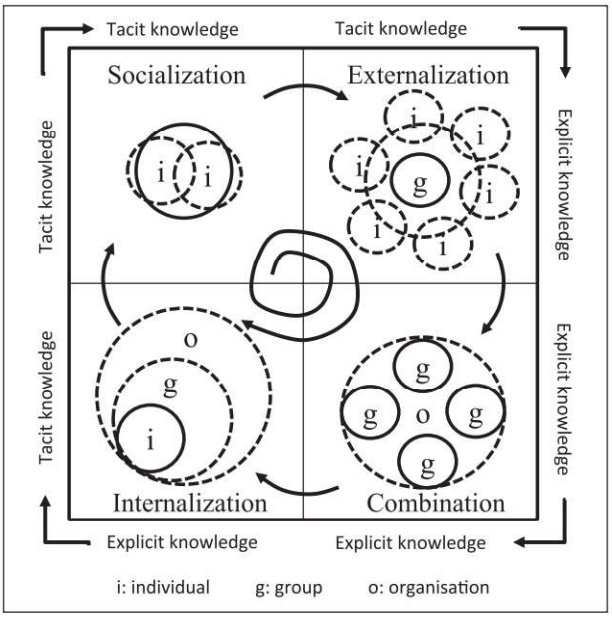

Figure 2.3. Spiral of organizational knowledge creation (Basten and Haamann, 2018; Nonaka and Konno, 1998).

Project information includes explicit and implicit knowledge that is difficult to explain and store, as well as knowledge that can be recorded quantitatively. Some of the information collected in a project relates to the market, collaborators (subcontractors, customers, partners, etc.) and the impact of strategic choices on the project value chain. In addition, organizational information in construction companies is more than the amount of data collected from projects (Cook and Yanow, 1993). Corporate data, purchasing, marketing, business development, financial management etc. may be changed due to "unrealized projects" that require practical experience in central office operations such as marketing, financial management, bidding, business development, financial management, and so forth (Cook and Yanow, 1993).

2.6.5. Exploration vs Exploitation

In his study conducted in 1991, March defined and compared the concepts of exploration and exploitation in organizational learning. Later, this subject has been cited and discussed many times in the literature. March developed the adaptive processes argument in his study, where he stated that exploitation is faster than exploration and stated that it is more "effective" for the near future, but "self-destructive" for the distant future. Discovery of new alternatives slows down the pace as currently applied methods and skills are improved. It is also clear that trying new methods is less attractive due to competitive advances in already existing procedures (Levitt and March, 1988).

The benefit of the returns from the exploration is systematically more distant, less certain, more farther in time than the returns obtained from exploitation. The distribution of learning over time and space determines what is learned as companies learn through experience how to allocate resources between exploitation and exploration. Because of these differences, adaptive processes characteristically develop exploitation faster than exploratory. For exploitation, these advantages accumulate. Every competitive activity increases the probability of the reward coming depending on the activity, so competition tends to increase as well. However, organizations that do not explore specific to their own targets and directions can never be ahead of the explorers in the long run, especially with the learning they get from the ones who explore.

2.6.6. Single Loop - Double Loop

The nature of organizational learning is of course largely based on how someone defines the organization. Argyris and Schön (1977) introduced the concepts of "single loop" and "double loop" learning as a generic notion as sub-headings describing organizational learning definitions. Single loop learning is the realization of learning by finding and correcting mistakes in response to changes in the internal and external environment of organizations in their own goals and directions (Barlow and Jashapara, 1998). Double loop learning, on the other hand, involves challenging existing organizational norms and assumptions to construct new ones. Learning organizations that want to be competitive must develop a double loop learning culture (Basten and Haamann, 2018).

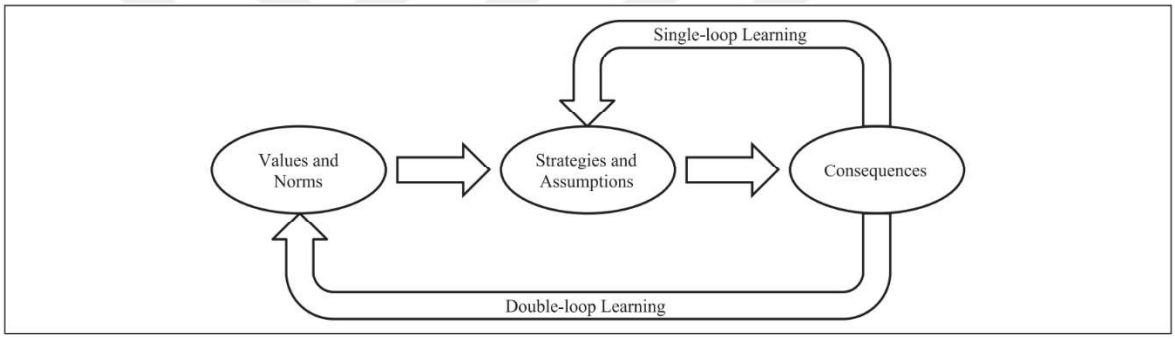

Figure 2.4. Single-loop and double-loop learning (Basten and Haamann, 2018; Argyris and Schön, 1996).

Single loop learning is "instrumental learning that changes strategies of action or assumptions underlying strategies in ways that leave the values of a theory of action unchanged" (Argyris and Schön, 1996). For example, correcting an error in the product can be given as an example of learning single loop in this regard (Bastin and Haaman, 2018). An engineer solves the problem in response to an incoming call as a single feedback loop in order to prevent future errors in a product. Single loop learning compares existing problems and the values and norms of the organization to develop a more suitable solution which can be seen in Figure 2.4. If the company's values and norms need to be adapted to correct the error, double loop learning is required here. The double loop is formed by the combination of two feed back loops and develops a strategy against observed errors. Potentially diverging organizational performance requirements may result in a conflict of interest between different members or units in the organization. To resolve such conflicts, new performance

strategies, trade-offs between different viewpoints, or the underlying causes of different perspectives need to be explored. For this, it is necessary to make some changes in the values and norms of the organization. Double loop learning is “which connects the detection of error not only to strategies and assumptions of effective performance but [also] to the values and norms that define effective performance” (Argyris and Schön, 1996).

2.6.7. Learning Organization

There is a lot of agreement and disagreement in the literature that the terms organizational learning and learning organization (LO) are often used interchangeably. As Tsang (1997) states, organizational learning covers certain types of activities that organizations implement to learn, while the LO defines the organization itself. However, there is a simple relationship between them, learning organization refers to the good in organizational learning. Therefore, according to Tsang, the difference between ‘being’ and ‘becoming’ is clear. Organizational learning is the initiative of organizations to promote learning by involving all company members in a conscious, systematic and synergetic atmosphere. The learning organization, on the other hand, represents the highest level of organizational learning, where it states that the organization is constantly open and ready to evolve and evolve with all its members.

According to Stata (1989), one of the most common features of learning organizations is the transition of a workforce from a simply 'working' workforce to a 'thinking' workforce (Kululanga et al., 2001). Different aspects of the learning organization have been introduced by Pedler et al. These included developing flexible organizational structures, rules and procedures, fostering experimentation and continuous improvement, and using knowledge to foster dialogue and inquiry in an engaging, stimulating and open way. They also emphasized the development of the company's strategy and policy through a participatory process (Lantelme and Formoso, 2000).

2.6.8. Five Building Blocks

Since the concept of learning organization actively promotes learning among organizational members to create competitive advantage and more benefits, it examines five

main items defined by Garvin (1993) how organizations should conduct an effective organizational learning process and how it is possible to master it. Garvin (1993) is one of the first studies to mention the concept of learning organization, and there the he aims to overcome the literature that he describes as too “utopian and impractical”. The five building blocks consist of systematic problem solving, experimentation, learning from past experiences, learning from others, and knowledge transfer.

2.5.8.1. Systematic Problem Solving. This first step is based on the philosophy, meaning and methods of quality-related activities. Its core ideas, now widely accepted, include: utilizing scientific methods rather than guessing to diagnose problems, insisting on data rather than assumptions as the foundation of decision making, using statistical tools to explain and present data.

2.5.8.2. Experimentation. Methodical research and testing of new knowledge is what this activity entails. There are clear parallels between systematic problem solving and the use of the scientific process. However, experiments are often guided by potential and expanding horizons rather than real problems, as opposed to problem solutions. It primarily takes the form of sustained initiatives and original promotional efforts.

2.5.8.3. Learning from Past Experiences. Businesses should analyze their successes and mistakes, evaluate them methodically, and document lessons learned in a clear, accessible style that staff can easily access. Unfortunately, many managers today have a negative or apathetic attitude towards the past, and by doing so they allow important information to be lost. The knowledge gained from failures typically occupies a crucial place in developing future achievements, failure can also be called the best teacher (Garvin, 1993; Maidique, 1985).

2.5.8.4. Learning from Others. It is obvious that, not all learning comes from self-assessment and analysis; sometimes, the deepest revelations come from taking a fresh look at one's surroundings. The “not invented here” attitude is being replaced by enthusiastic borrowing, according to enlightened CEOs who understand that even businesses in completely unrelated business sectors can serve as productive sources of ideas and accelerators for creative thinking. The concept of “Shamelessly Stealing Ideas” which

defined by Milliken, stands for a more general word of benchmarking. Benchmarking is a way to get an outside perspective; for example consumers are another equally productive source of ideas. Talking to consumers encourages continuous learning because they are professionals at what they do. Learning takes place only in a receptive environment, regardless of the source of outside ideas.

2.5.8.5. Knowledge Transfer. To make of learning term to be more than just a unit level effort, knowledge must be disseminated quickly and effectively within the company. Ideas work best when they are widely spread rather than kept in close proximity. This process is supported by a number of mechanisms such as written, oral and visual reports, site visits, staff rotation programmes, education and training initiatives and standardization initiatives. Each has its own advantages and disadvantages.

2.6.9. Building Information Modeling to Enhance Organizational Learning

The construction industry is often criticized by researchers and practitioners for not being innovative, not producing new knowledge, and not developing practices effectively to develop. Building Information Modeling (BIM), which refers to digital representations of facilities to be built, is a leading promising technological advance proposed to help share information and create connections between firms. There is little research and evidence of BIM and its ability to enhance learning in construction companies. Ahankoob's study (2015) identifies six "functionally attributed" features of BIM that act as triggers to promote learning: (1) comprehensibility, (2) predictability, (3) accuracy, (4) transparency, (5) mutual understanding and (6) integration.

While BIM gives academics and business professionals the chance to virtually experience real-world construction processes, there is little evidence that BIM can actually make it easier for people to learn about the construction industry. By collecting, sharing and retrieving various types of data at various stages of the building lifecycle, BIM is thought to offer a continuous learning process. BIM is more than a simple modeling technique as it influences activities such as interdisciplinary communication and continuous feedback (Eastman et al., 2008). The study highlighted BIM's capacity to enable "learning by doing" in projects, but did not identify specific BIM usage features that support project participants'

collaborative learning Lu et al. (2013). Below is a summary of six “functional attributed” features that Ahankoob identified as BIM promoting learning.

2.5.9.1. Comprehensibility. Project participants can gain a comprehensive understanding of all aspects of a building project through the BIM virtual environment.

2.5.9.2. Predictability. Construction will be more efficient if contractors can better consider and anticipate potential problems. BIM construction simulation makes potential conflicts more predictable before the construction phase (Eastman et al., 2011).

2.5.9.3. Accuracy. A quantity surveyor or cost engineer can provide more reliable and precise cost estimates by specifying different degrees of information in a BIM model (Ma et al., 2013).

2.5.9.4. Transparency. Businesses can create more transparent working conditions by taking advantage of the technological features of BIM. Participants are more motivated to exchange expertise and take tips from partners in an open setting (Lipshitz et al., 2002).

2.5.9.5. Mutual Understanding. Exchanging information and reaching consensus becomes less stressful when a partner has extensive knowledge of the demands of others (Nyström, 2005). Barlow and Jashapara (1998) emphasize that the degree of mutual understanding increases when participants from the later assembly stages are brought to the planning stage for direct negotiation and problem resolution.

2.5.9.6. Integration. By using the technological possibilities of BIM, businesses can improve the integration of project processes and participants. An integrated database system is said to improve the ability of supply chain partners to share operational information (Shang, 2009).

2.6.10. Lean Production And Organizational Learning

Although managers of construction companies are aware of the importance of performance measurement, applications are not common in the industry. Most managers

make decisions based on their gut feelings and perceptions in the industry, and sometimes they only evaluate a few financial metrics. However, this is not appropriate in a competitive environment. However, in the theoretical framework of lean construction, performance evaluation occupies a very important place as it provides process transparency. It makes the invisible visible, enables employees to evaluate themselves and their performance, and provides an atmosphere that will enable decentralized control to be applied. Performance measurement plays an important role in helping people and resources serve a specific business purpose, and Schieman and Lingle (1999) surveyed more than 200 senior executives and found that companies that exhibit performance measurement practices outperform. However, it is very difficult to implement performance measurement systems in the construction industry due to the following reasons: the construction industry is a project-oriented industry and therefore products, conditions and site are constantly changing and temporary organizations are established. Secondly, construction projects are usually complex projects, involve a large number of different teams and consist of a complex process process. Toyota's Production System concepts and principles provide a wide range of applications for performance measurement when applied across many industries. Performance measurement systems in the Toyota Production System are strongly dependent on decentralized control. Metrics are heavily used in the operational level learning project, where employees allow them to see how centralized control systems are performing rather than the feedback data they provide.

The following recommendation points made by Lantelme and Formoso (2000) aim to establish the framework for the application of performance measurement in the construction industry. They can be applied to the creation or evaluation of existing measurement systems:

2.5.10.1. Transparency. The idea of increasing process transparency requires performance evaluation, but its effectiveness also depends on the availability of additional transparency-related elements. This requires the establishment of a more independent, participatory decision-making process, as well as the clear sharing, communication and presentation of information.

2.5.10.2. Moments for Reflection. In order to analyze the outputs and create new strategies, official times determined within certain working hours should be established. These

meetings need to be open to everyone and encourage discussion, introspection and creative expression.

2.5.10.3. System Thinking. This approach of thinking must be used consistently to fully understand the factors that influence results. Because the causes of problems are often dispersed across space and time, organizations can gain leverage only by understanding system complexity and dynamics.

2.5.10.4. Reducing Cycle Time. Processing times should be shortened to provide timely information for improvement. Automated data collection, processing and use of internal computer networks can be important factors in this particular issue.

2.5.10.5. Simplification. This requires the use of control systems and processes already in place in the company, while reducing the number of measures required. To make each metric simpler for everyone in the firm to grasp, it should also be critically reviewed and adjusted if necessary. As a result of simplification, costs are reduced and reliability is increased.

2.5.10.6. Benchmarking. Setting difficult goals and linking them to the company's strategic goals is essential for the continuous improvement of measurement systems. With benchmarking, managers can compare their current performance with that of their competitors and regularly evaluate procedures.

The issue of performance evaluation have a particularly important position in adapting lean production concepts and principles according to the needs of the construction industry, taking as examples from applications in production management. Measurements especially play a critical role in providing transparency in the process and providing the knowledge necessary for continuous improvement.

2.6.11. Organizational Learning and Sustainability

Organizational learning has been identified in the literature in a key position for the survivability and sustainability of organizations. Due to its high economic importance and strong environmental and social effects, the concept of sustainability is also at the core of

construction industry practices. Especially in many developed countries, construction organizations are working to increase their knowledge and experience in order to meet the rules and demand for providing sustainable services. However, this process is still in its infancy and there is a great need for organizational learning in the construction industry and its practices for sustainable change. According to Opoku and Fortune's study (2011), organizations must engage with learning to embrace sustainability, and the study has shown that little research has been done on the concepts of learning and sustainability in organizations. More attention must be given to this issue, especially given the current economic uncertainty and turbulent economy.

Many construction organizations are looking for many ways to stay competitive and be successful, Chan et al. (2004) stated in his study that the key factor that determines the survival and life span of a company is organizational learning. However, construction companies have difficulties in adopting new management styles and technologies, Barlow and Jashapara (1998) stated that people involved in construction projects do not adequately transfer their experiences to the next project. Due to the multi-fragmented structure of the sector, this experience remains with the individuals of the organization and then disappears. The relationship between sustainable development and the construction industry has thus become clear, as the construction industry has high economic importance and strong environmental and social impacts.

Due to poorly developed or inappropriate knowledge acquisition systems in the construction sector, knowledge and experience remain at the individual level and do not reach the organizational level (Barlow and Jashapara, 1998). Sustainable development emerges as a rapidly developing, effective way that sheds light on social, economic and environmental concerns in the world in addition to sustainable knowledge transfer among the organizations. It is also a very important social responsibility of the construction industry to minimize the damage caused by its projects to the nature. The three spheres of sustainability which are environmental, social and economic presented by Rodriguez et al. (2002) and can be seen in Figure 2.5. In addition to the profitability of the company, sustainability at the organizational level is a very important issue for organizations to be sensitive to social and environmental factors (Porter, 2008). Learning and development processes emerge as an important path for a sustainable development agenda. Construction

organizations must integrate concerns in their social and environmental operations, and this is only possible by developing solutions and standards relevant to the learning (Muller and Siebenhuner, 2007). Progress to meet sustainable construction requirements is possible with the combination of the learning actions of both the individuals in the organization and government (Holton et al., 2008).

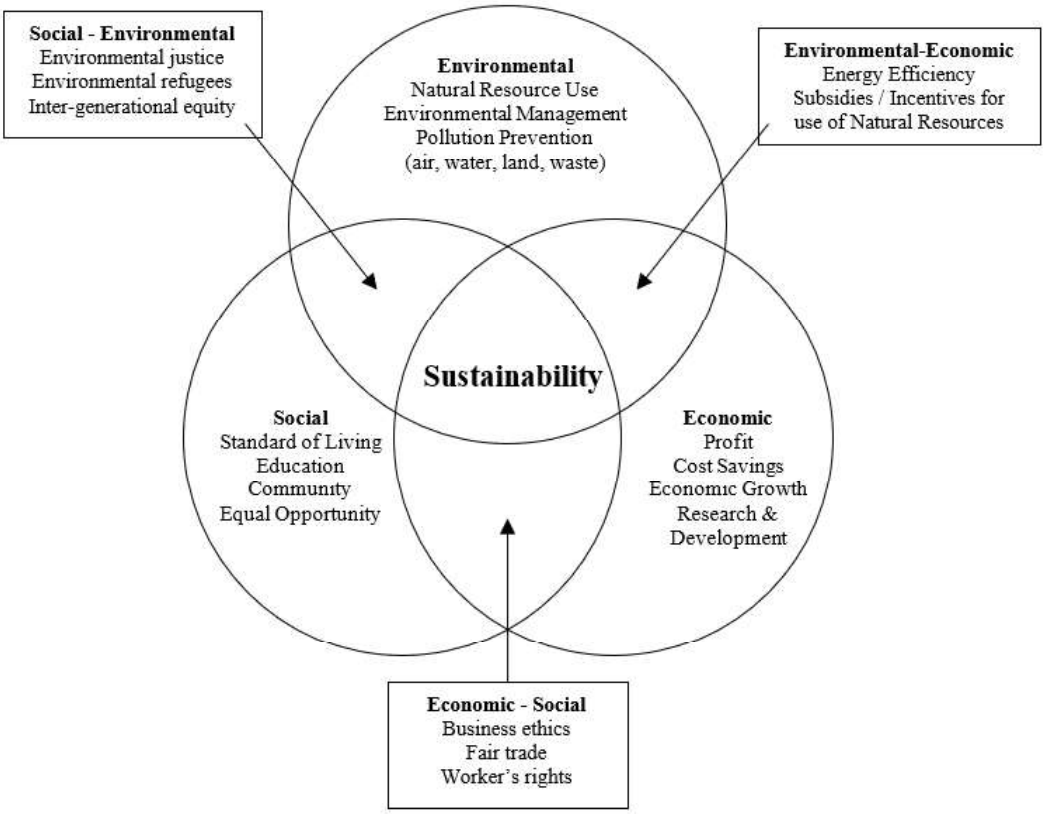

Figure 2.5. Three spheres of sustainability (Opoku and Fortune, 2011; Rodriguez et al., 2002).

2.7. Frameworks for Organizational Learning

In the literature, many researchers have proposed different frameworks to explain and analyze organizational learning and to make the concept more understandable. Some of these describe the organizational learning process, while others examine the layers of the process, its effects, and its relationship with environmental factors. Within the scope of this thesis study, it is aimed to examine the concept of organizational learning in a broad framework

and to prepare a framework. Therefore, in this section, different frameworks of different researchers in the literature are examined and briefly summarized.

2.7.1. Argote and Miron-Spektor's Framework

In order to make organizational learning more analytically traceable, a framework for evaluating organizational learning is proposed by Argote and Miron-Spektor (2011) in the Figure 2.6. In the study of the organizational learning process evolves over time, so the picture tries to show an ongoing cycle in which experience gained from job performance is transformed, knowledge that subsequently changes the organizational context and influences subsequent experience. Both the organization and its environment exist in the setting where organizational learning takes place (Glynn et al., 1994).

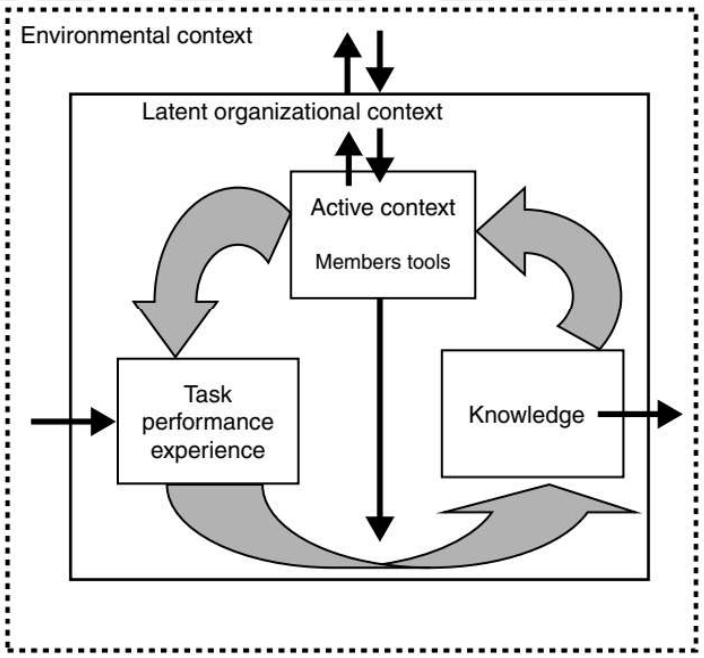

Figure 2.6. Theoretical framework for analyzing organizational learning (Argote and Miron-Spektor, 2011).

Figure 2.6 shows a learning cycle and uses curved arrows to show learning processes. Argote and Miron-Spektor (2011) refer to the learning sub-process as knowledge creation when knowledge is created directly from the experiences of one unit, and knowledge transfer when knowledge is developed directly from the experiences of another unit. Consequently,

the curved arrow at the bottom of the diagram indicates either the knowledge transfer or the creation subprocess. The curved arrow moving from knowledge to active context in the upper right quadrant of Figure 2.6 represents a third subprocess, information storage. This procedure is used to store information within the company. In conclusion, it is considered that knowledge generation, storage and transfer as three sub-processes that make up organizational learning processes. They interact with each other. For example, the diffusion of knowledge can lead to the creation of new knowledge (Miller et al. 2007).

2.7.2. Chan et al.'s Model

Chan et al. prepared a comprehensive framework depending on the model of Lipshitz et al. (2002). For the first time, Lipshitz et al. (2002) present a comprehensive conceptual framework that clearly connects organizational learning and learning organizations (Chan et al., 2004) which can be seen in Figure 2.7.

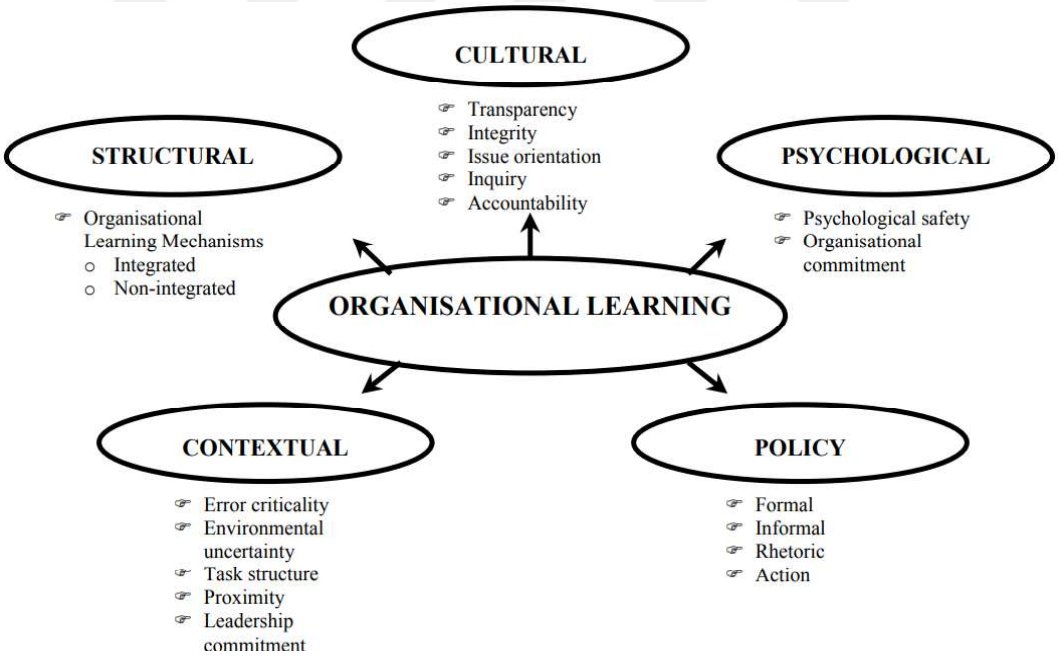

Figure 2.7. Multifacet model of organizational learning (Chan et al., 2004; Lipshitz et. al., 2002).

Huysman (2000) identified four types of knowledge: individual, transmitted, organizational, and environmental (or external) that are linked through internalization, externalization, objectification, adaptation, and institutionalization to understand how organizational learning transcends individual learning (Chan et al., 2004), process can be seen in Figure 2.8.

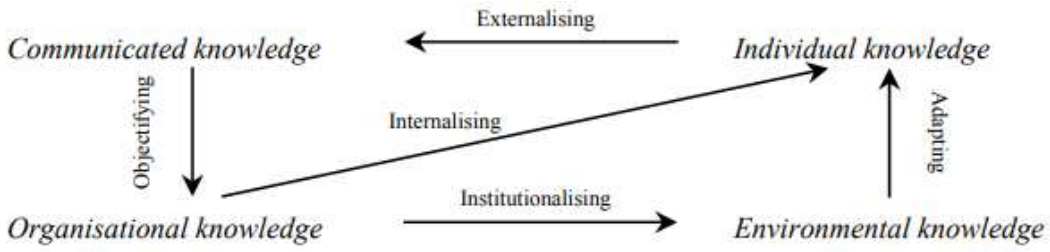

Figure 2.8. Learning as institutionalising (Chan et al., 2004; Huysman, 2000).

Huysman's model allegedly reflects a 'learning process' model, but despite its overt effort to highlight cultural and structural implications, it lacks the obvious link that can be used to define the foundation of a learning organization. It is sure that, Huysman's "learning process" is simply fit into the structural component of the model developed by Lipshitz et al. (2002). According to Chan et al. (2004), two-way affective organizational learning procedures proposed by Lahteenmaki et al. (2001) which can be seen in Figure 2.9 presents some improvements, but their model fall behind of comprehensiveness of model of Lipshitz et al. (2002).

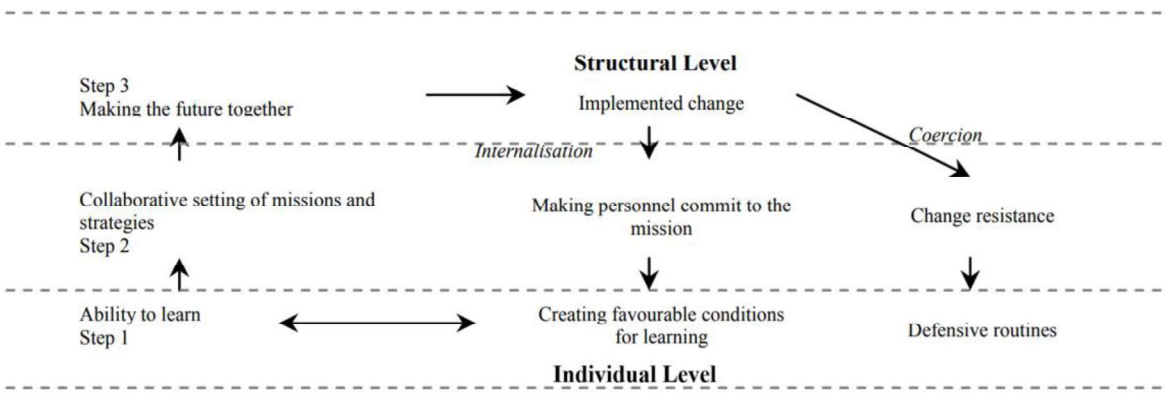

Figure 2.9. The two-way affective process of organizational learning (Chan et al., 2004; Lahteenmaki et. al., 2001).

2.7.3. Dikmen et al.'s Framework

A framework for learning was put out by Kululanga and colleagues (1999), who also highlighted several important learning mechanisms. Empirical study was also carried out, and businesses' OL skills were assessed based on the presented models (Dikmen et al., 2005; Kululanga et al., 2002; Kululanga et al., 2001). Figure 2.10. provides a picture of the conceptual OL framework presented by Dikmen et al. (2005).

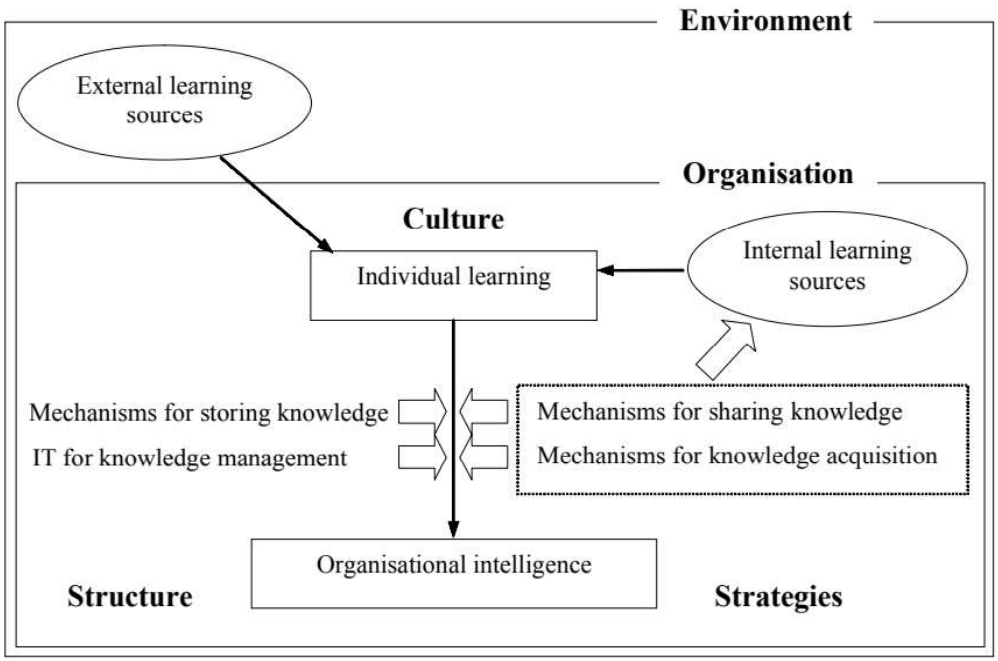

Figure 2.10. The framework of OL (Dikmen et al., 2005).

The proposed framework has three main parts: "learning resources", "learning procedures" and "organizational environment". Resources used by people to learn are called learning resources and they can be internal or external. Internal resources are shared internally, while external resources are developed outside the company. Individuals or groups inside or outside the company might serve as learning resources. Learning mechanisms are instruments for converting solitary information into collective knowledge. To gather, share, store, and disseminate knowledge, knowledge management systems are employed. Instruments used to institutionalize knowledge include instruments such as IT tools and actions as post-project evaluations.

2.7.4. Kogut and Zander's Model

A route map for Kogut and Zander's (1992) organizational learning process is shown in Figure 2.11. They have started by examining the firm's data in their study, separating information about pricing, for example, from knowledge about the division. Investigation on how knowledge may be merged through internal and external learning is built upon this static portrait. The possibility for further exploitation of editing ideas and technology is a significant barrier to the acquisition of new abilities. A particular technology or organizational technique eventually experiences diminishing returns, which creates the motivation to acquire new but viable capabilities. They propose that these investments in innovative applications act as a stepping stone to potential future market possibilities (Kogut and Zander, 1992).

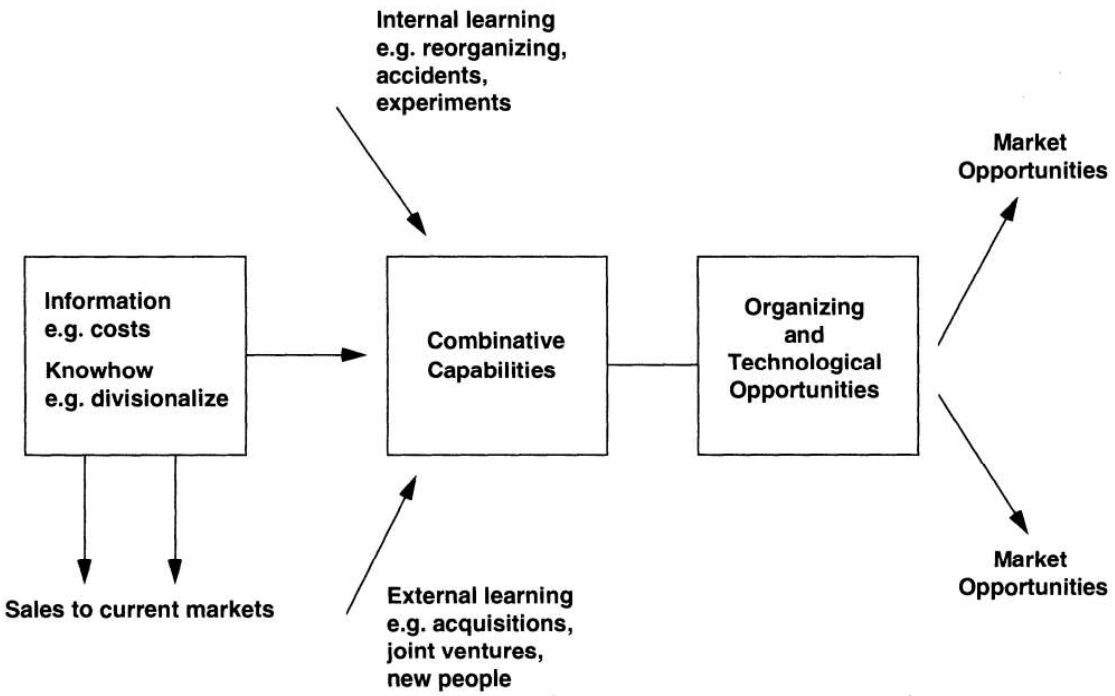

Figure 2.11. Growth of knowledge of the firm (Kogut and Zander, 1992).

Table 2.3. Framework for measuring knowledge management (Kululanga and McCaffer, 2001).

Scale	Collection of knowledge	Creation of knowledge	Transferring knowledge	Sharing knowledge	Storage of knowledge in repositories	Knowledge utilization	Rewarding for new knowledge	Shared vision in knowledge is the need of a company	Committed leadership to knowledge management
4	The company encourages everyone to collect internal and external knowledge	The company encourages every employee, unit and department in the production of new knowledge	Mechanical, electronic and interpersonal modes of knowledge transfer are fully used	The company encourages all employees to think creatively, interact in teams and demonstrate tasks and insights so that others can understand easily	The company stores informal and formal knowledge in a systematic and organized process	The company uses created and captured knowledge to improve its business processes at all levels for effectiveness and efficiency	The company rewards employees and groups for creative ideas	The company's knowledge development is based on a shared vision	Management is committed to acquisition, creation, sharing, utilization and storage of knowledge
3	Key employees are involved in collecting internal and external knowledge	Key employees and units are involved in the production of new knowledge	Mechanical, electronic and interpersonal modes of knowledge transfer are partially used	The company partially encourages employees to think creatively, interact in teams and demonstrate tasks and insights so that others can understand easily	The company partially stores informal and formal knowledge	The company partially uses created and captured knowledge to improve its business processes at all levels for effectiveness and efficiency	The company partially rewards its employees for creative ideas	The company's knowledge development is partially based on a shared vision	Management is partially committed to acquisition, creation, sharing, utilization and storage of knowledge
2	The company is considering encouraging employees to collect internal and external knowledge	The company is considering encouraging employees to get involved in the production of new knowledge	The company is considering using mechanical, electronic and interpersonal modes of transferring knowledge	The company is considering encouraging employees to think creatively, interact in teams and demonstrate tasks and insights so that others can understand easily	The company is considering putting in place mechanisms for storing knowledge	The company is considering using created and captured knowledge to improve its business processes	The company is considering putting in place systems for rewarding employees for innovative ideas	The company is considering developing knowledge based on a shared vision	Management is considering to become committed to acquisition, creation, sharing, utilization and storage of knowledge
1	The importance of encouraging employees to collect internal and external knowledge is known but not carried out	The importance of involving every employee, units and departments in the production of new knowledge is known but not carried out	The importance of knowledge transfer by mechanical, electronic and interpersonal is known but not working	The importance of encouraging employees to think creatively, interact in teams and demonstrate tasks and insights so that others can understand easily is known but not performed	The importance of storing informal and formal knowledge is known but not carried out	The importance of utilizing created and captured knowledge to improve business processes is known but not carried out	The importance of rewarding employees and groups for innovative ideas is know but not performed	The importance of developing knowledge based on a shared vision is known but not carried out	Management recognizes the importance of acquisition, creation, sharing, utilization and storage of knowledge but is not performed
0	The company has no interest in encouraging employees to collect internal and external knowledge	The company has no interest in producing new knowledge by its employees, units and departments	The company has no interest in transferring knowledge through mechanical, electronic and interpersonal mechanisms	The company has no interest in encouraging employees to think creatively, interact in teams and demonstrate tasks and insights so that others can understand easily	No repositories exist for storing formal and informal knowledge	The company has no interest in improving its business processes through knowledge management	The company does not reward its employees for their creative ideas	The company has no interest in developing knowledge based on its shared vision	Management has no interest in acquisition, creation, sharing, utilization and storage of knowledge

2.7.5. Kululanga and McCaffer's Model

Based on the disclosure indicators shown in Table 2.3, Kululanga and McCaffer (2001) created a framework for monitoring knowledge management. To help construction firms statistically assess the condition of knowledge management inside their organizations, declaration indicators are linked to a scale. The framework should rapidly determine if and how well the necessary activities have been carried out. Similarly, a mapping procedure can make it simpler to contrast the knowledge management improvement processes of various construction organizations.

2.7.6. Ozorhon et al.'s Organizational Memory Framework

Figure 2.12 proposed by Ozorhon et al. (2005) depicts the creation of organizational memory (OM), its usage in decision-making, and its revision. One's personal experience with the firm, experience of other companies, and information from outside sources are the three elements that make up OM. Strategic choices are made with OM in mind, and once actions are completed, fresh experiences are added to OM (Ozorhon et al., 2005).

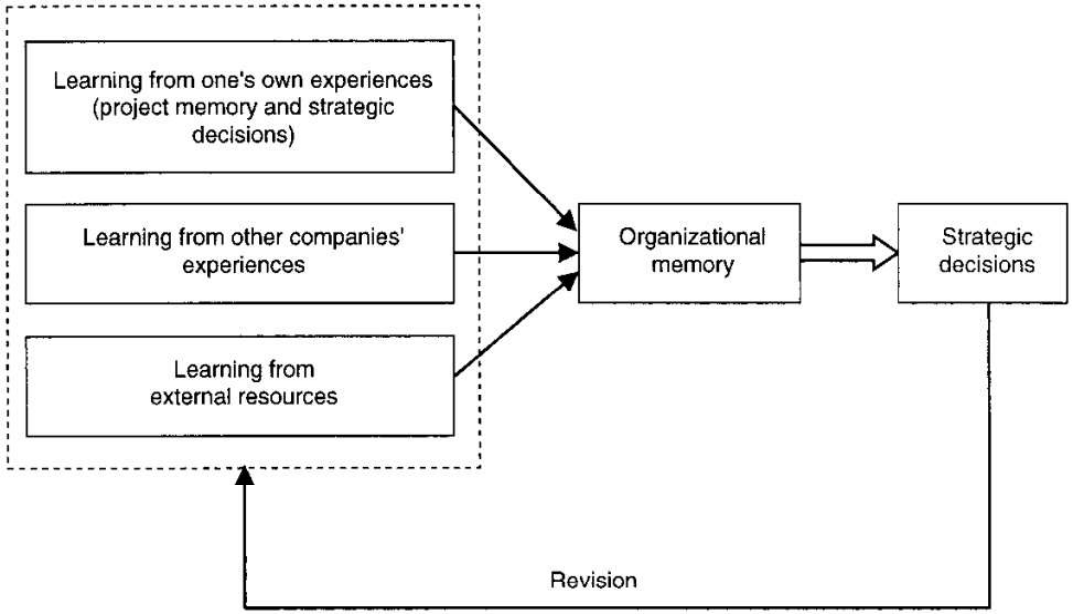

Figure 2.12. Framework explaining the organizational memory formation and utilization (Ozorhon et al., 2005).

2.7.7. Senaratne and Malewana's Model

Senaratne and Malewana (2011) created a conceptual model by mapping literature findings, which is shown in Figure 2.13. Murray and Moses (2005) model, which centrally regulates team level behavior, serves as the foundation for this approach. The primary point of this research, that the individual level is crucial to construction project teams' learning processes, has led to a modification of this model for a team environment (Senaratne and Malewana, 2011). Each learning transformation link shows the influencing elements at the individual, team, and organizational levels that affect learning transformation processes. The theoretical underpinning for this conceptual model is utilized to direct empirical research.

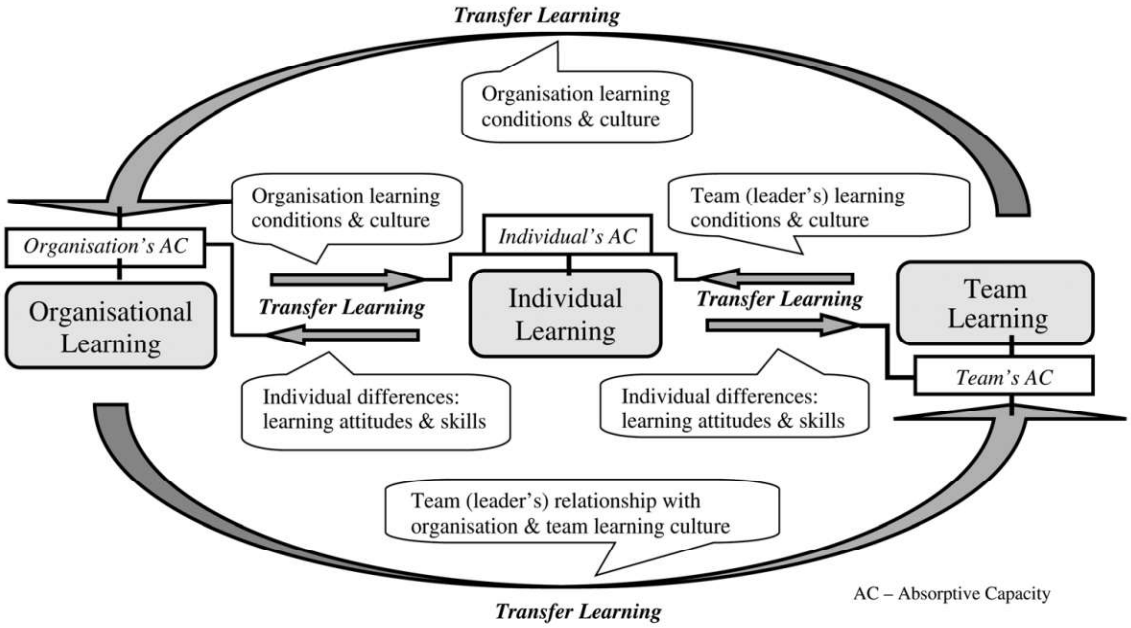

Figure 2.13. Conceptual organizational learning model (Senaratne and Malewana, 2011).

2.7.8. Kumaraswamy's Model

Figure 2.14 proposed by Kumaraswamy (2006) presents a conceptual summary model based on the datasets of the study for the purposes of publication and also to serve as a general framework for further development and operationalization. According to this study, the development in the construction sector is linked to the specified barriers, national and

infrastructural development, and specific drivers. In addition, the effect relationship between these substances is indicated by arrows.

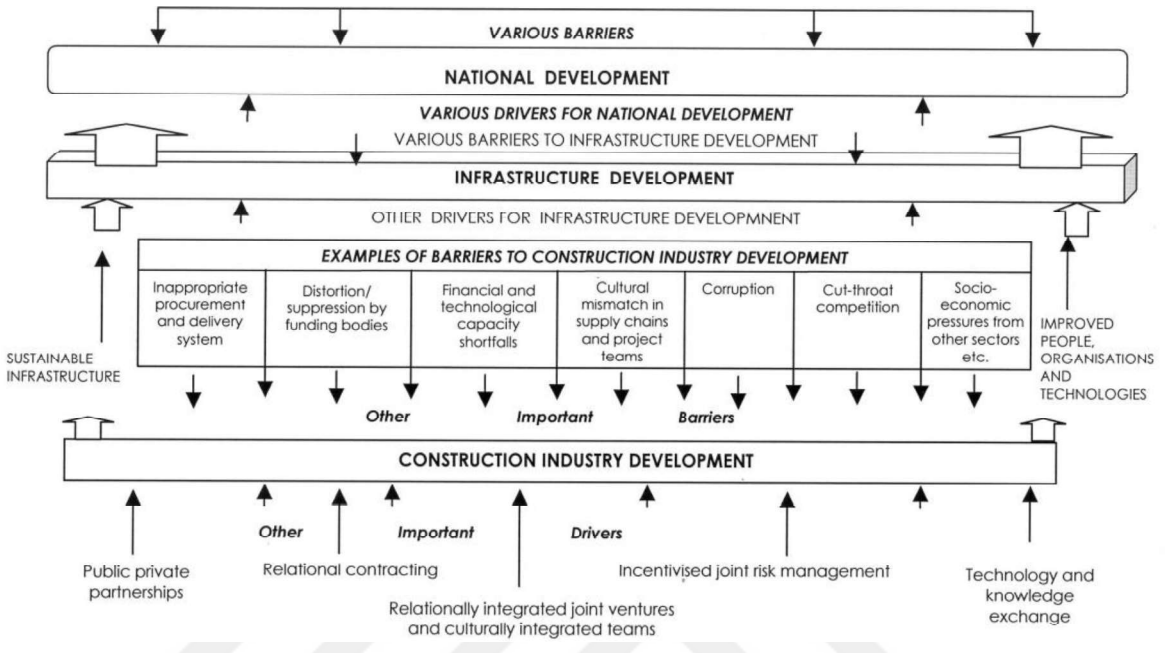

Figure 2.14. Targeting construction industry development: basic framework for identifying drivers, barriers and linkages (Kumaraswamy, 2006).

2.7.9. Lawrence et al.'s Model

Crossan et al. (1999) made an important contribution to the development of a suitable model, commonly known as the 4I model, for the OL process. The 4I model assumes four processes in which OL at various levels (individual, group and organisation) are linked in both directions:

2.6.11.1. Intuition. New insights and ideas are developed within the individual based on personal experience.

2.6.11.2. Interpretation. In this stage, the person expresses his insights verbally or non-verbally to himself and more importantly to others.

2.6.11.3. Integration. In this process, which takes place at the group level, individuals and groups reach a common understanding that enables credible, coordinated action within the organization.

2.6.11.4. Institutionalization. Finally, common understanding becomes independent of individual or group origins by being incorporated into the systems, structures, processes, norms and tactics that guide institutional action.

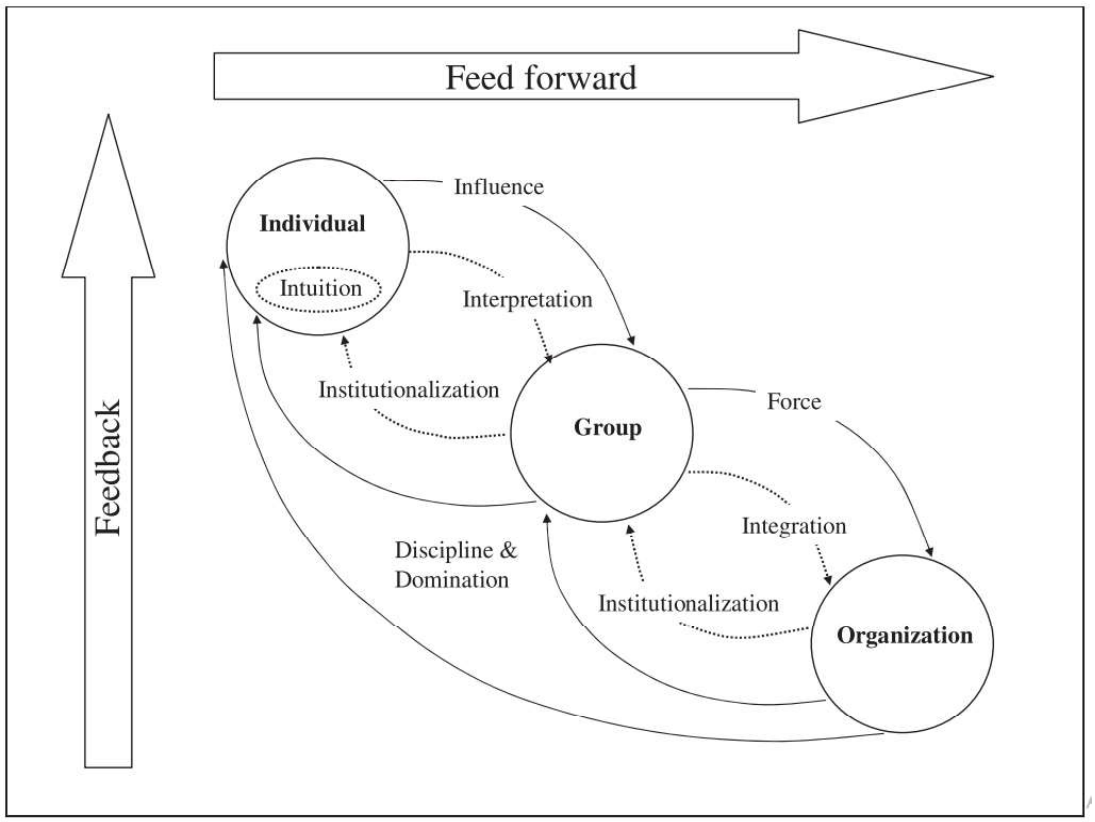

Figure 2.15. The social psychological and political processes of organizational learning (Schilling and Kluge, 2009; Lawrence et al., 2005).

Lawrence et al. (2005) are complemented these four main steps of the progress by the four sociopolitical processes called influence, force, discipline, and domination as seen in Figure 2.15.

The 4I model is then enlarged, as seen in Figure 2.16 by Schilling and Kluge (2009) based on model of Lawrence et al. (2005). Members' perceptions of the social and physical

world's suitability for organizational activity are represented by the environment. It is presented as the organization's history as it has been practiced (Weick, 1977) by members of the organization at various levels (individual, group, and organizational). Instead of representing the trade of commodities and services, the interaction between the organization and its surroundings is intended to depict the flow and processing of information (Schilling and Kluge, 2009).

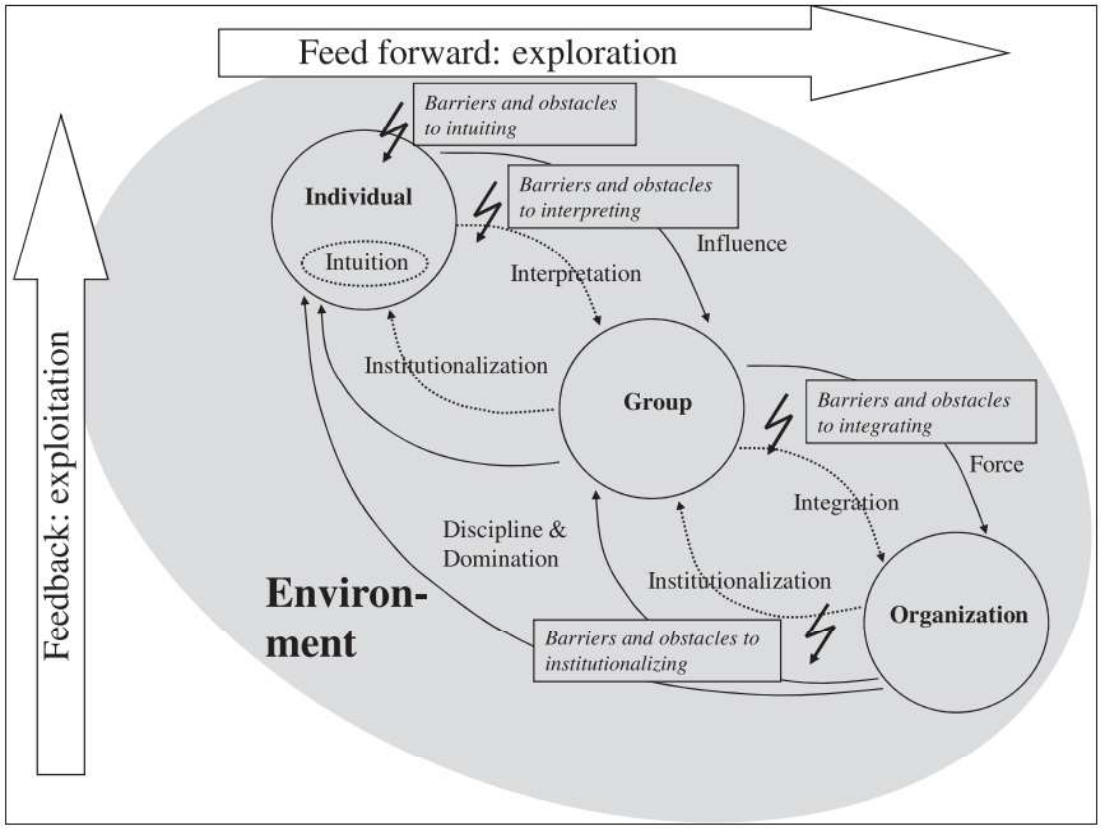

Figure 2.16. The expanded 4I model of the organizational learning process and its barriers (Schilling and Kluge, 2009).

2.7.10. Zou and Lim's Model

Zou and Lim (2002) studied how businesses learn and created a model for organizational learning process which can be seen in Figure 2.17. In the study, the organizational learning and knowledge management process is divided into five main steps in total. First, in the planning step, the multifunctional knowledge management (KM) team, senior management and members representing different departments of the company analyze

and integrate information in company operations as an asset. Then, after the information management infrastructure is established, the necessary systems for capturing, transferring, sharing, storing and reusing information are prepared. In these processes, pilot studies and information management systems tests are carried out, and it is very important to encourage open communication throughout this process. The entire system learns, as it decodes signals from the feedback of KM processes and facilitates planning for future change (Zou and Lim, 2002). The feedback from the KM system provides organized and systematic data that form the basis for OL. Therefore, construction work needs to give a chance to learn through knowledge sharing, task delegation and job rotation (Zou and Lim, 2002).

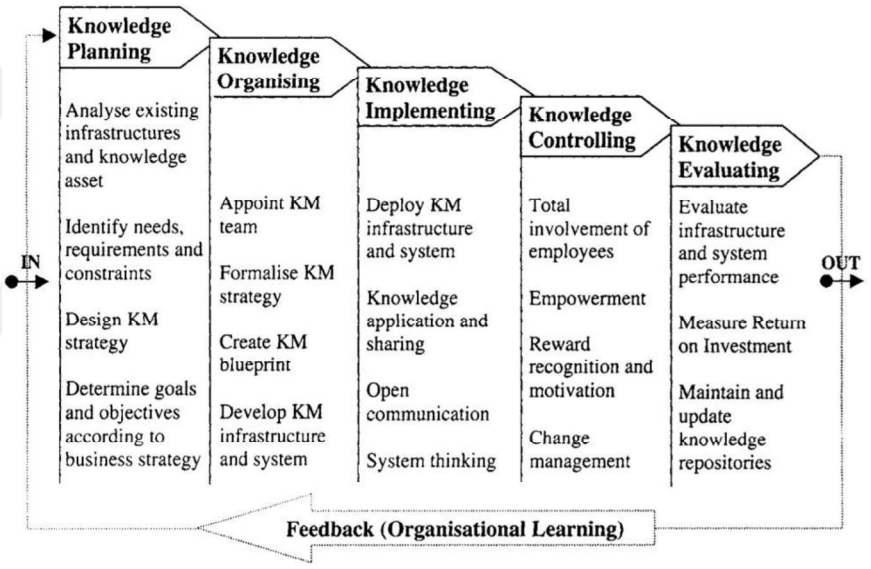

Figure 2.17. Proposed KM-OL model for construction company (Zou and Lim, 2002).

3. RESEARCH METHODOLOGY

Within the scope of this thesis, it was decided to use both qualitative and quantitative approaches as a result of research on how the study could best address the investigation of organizational learning. The research methodology steps in this study are presented in Figure 3.1.

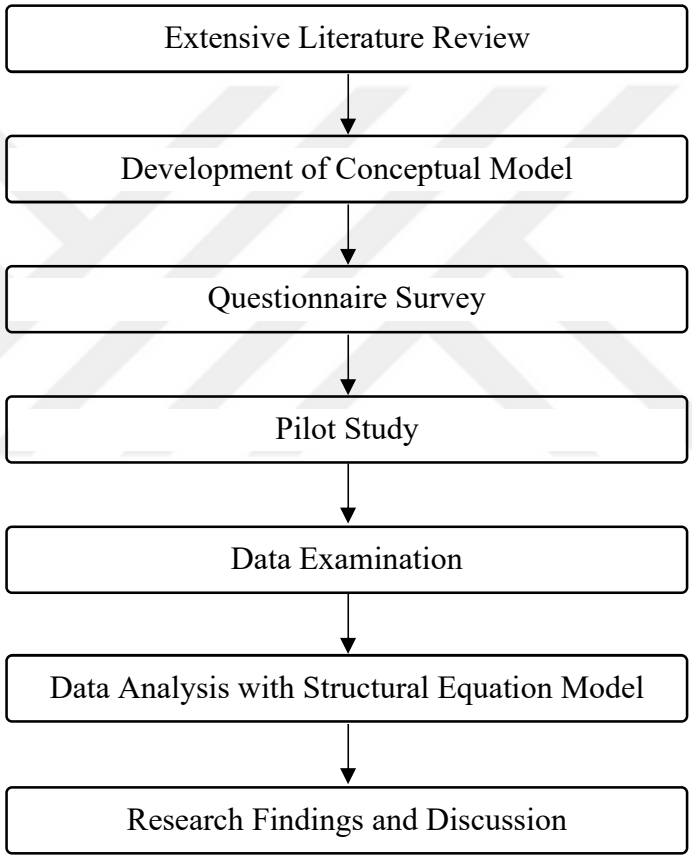

Figure 3.1. Research methodology steps.

First of all, a comprehensive literature review was conducted in order to reveal a qualitative background on organizational learning. Here, articles on the subject were obtained by using the tags “organizational learning”, “knowledge management”, “organizational learning in the construction industry”, “learning organization”, taking into account the number of citations of the articles and the journals in which they were published. Then, in order to create a conceptual model, the models and frameworks prepared for

organizational learning in the literature were examined in detail and their partnerships or differences were examined. The models and frameworks that have been reviewed are also summarized in the previous chapter. Afterwards, after the conceptual framework was prepared, a questionnaire survey was prepared in order to conduct a quantitative research. Then, the questionnaire was sent as a pilot study to five professionals working in the construction industry in Turkey in order to get preliminary feedback on the survey, to understand whether it is understandable and to find out if there is a missing part, and feedback was received from them. According to these feedbacks, certain changes were made in the study and it was decided to use a more understandable language in the majority. This questionnaire, which has edited later, was sent to professionals working in the construction industry in Turkey and data was collected from them. The collected data was then subjected to a preliminary examination and analysis, and surveys of some participants were eliminated. The relationship and structure between the units prepared in the concept model were prepared as a model by using the SEM method and the relationships were analyzed. Initial and final models were developed in accordance with the SEM application steps. After the analysis of the data, the research outputs were presented and the relevant comments were stated by comparing them with the existing literature studies.

3.1. Development of Conceptual Model

One of the main goals of this thesis study is to prepare a framework that examines the concept of organizational learning in a wide framework in accordance with the reviewed literature. Huysman (2000) indicated that first need to have greater conceptual understandings of how organizational learning processes work in order to establish a learning organization that is effective in this area. For this reason, the model prepared by after examination of many different scholars in the literature and prepared the most inclusive and comprehensive model. Based on the frameworks and models examined in the literature, inferences were made for the comprehensive framework to be prepared. In the Argote and Miron-Spektor (2011) framework, knowledge creation takes place through the experience of one unit or the transfer of knowledge gained from the experience of the other. This shows that the inputs constitute the basic step in the learning process. According to Chan et al. (2004) learning occurs in structural and individual level which can be seen in their model. As the subject of this thesis is organizational learning, project level and corporate level were

chosen to examine learning at different levels of organizational learning impacts. Dikmen et al. (2005) included internal and external learning sources of the learning mechanism in his model. Based on this, it was decided to include the sources of organizational learning in the model to be presented. In the Kululanga and McCaffer (2001) framework, specific questions have been set to measure knowledge management, in which it is measured how many facilitators companies have identified. The model to be prepared includes enablers and some of these enablers are based on this framework. Ozorhon et al. (2005) included organizational memory resources in its framework. Kumaraswamy (2006) also included barriers in the framework he presented, and based on this, it was decided to include barriers in the model to be presented.

The final prepared model is based on the innovation process framework presented by Ozorhon (2013), as seen in Figure 3.2, it also influenced by different models and included those aspects which were examined in Chapter 2.1.

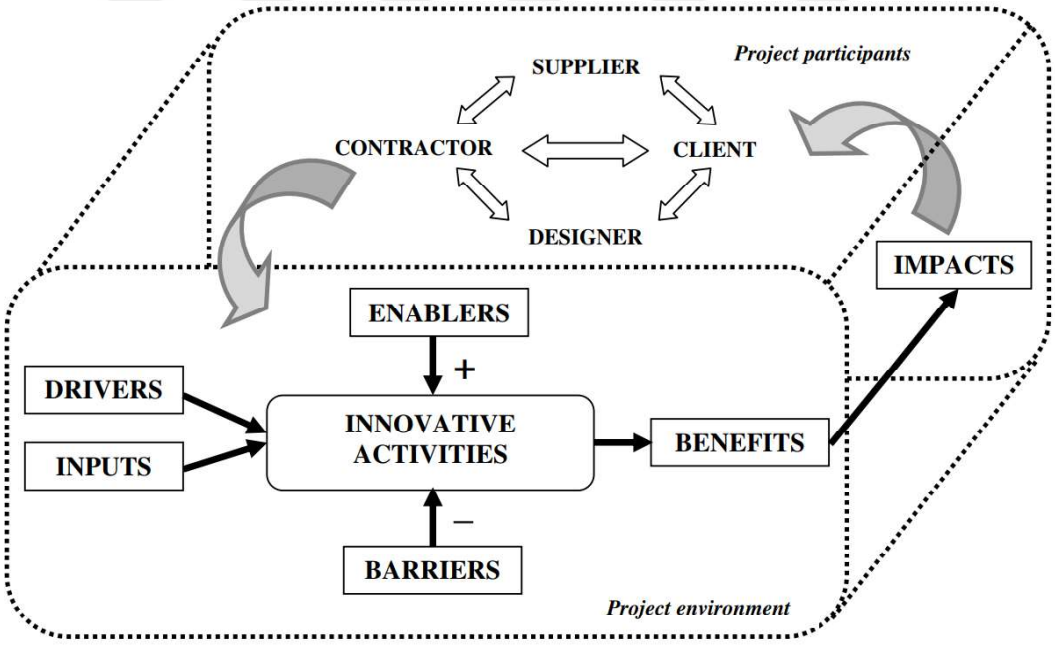

Figure 3.2. Framework to explain the innovation process in a construction project setting (Ozorhon, 2013).

The innovation process framework prepared by Ozorhon (2013) has been updated in accordance with this thesis and is presented in Figure 3.3. Here, unlike the existing based framework, the impacts of organizational learning at the organizational level and its benefits

at the project level are examined. In addition, the relationship is also modeled from impact to benefit, as impacts at the organizational level will also have benefits at the project level. In addition, a literature review was conducted for the levels of organizational learning which is explained in the next chapter and then regarding those main factors and sub-factors selected.

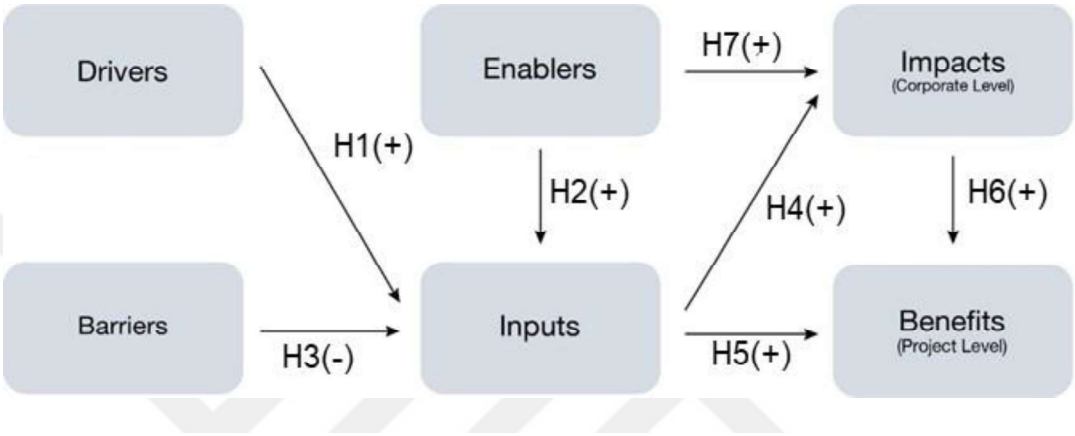

Figure 3.3. Proposed organizational learning framework.

3.2. Hypotheses of the Research

According to the literature review, examined frameworks, and reference model the relations between the organizational learning components, various hypotheses are structured which can be seen also in the Figure 3.3. Below each hypothesis, interrelations from the relevant literature or relevant model are presented. As mentioned in Chapter 3.1, the components of the framework were prepared based on the Ozorhon's (2013) framework in order to examine the subject from a wide scope. However, the relationship between the components has been prepared based on the literature review and the models examined.

- **H1: Drivers have a positive effect on inputs.**

Within the scope of this study drivers are described as the driving forces for companies to organizational learning while inputs are described as the learning resources. It has been hypothesized that the driver factors have a positive effect on learning which directing companies to the resources of learning. Process of learning requires a resource to learn which can be existing knowledge (Huber, 1991), experience of others (Ahankoob et al., 2015), or

organizational routines (Eken et al., 2020). Therefore, it can be expected that drivers component has an positive effect on inputs component.

- **H2: Enablers have a positive effect on inputs.**

Learning process begins from the resource of knowledge whether it can be internal or external and within the scope of this thesis study the enablers are explained as the facilitators of process. Therefore, it is hypothesized that enablers would directly have a positive effect on inputs. As an example, Kululanga et al. (2002) mentioned that as an enabler "climate of openness" has a positive impact on organizational learning and Ozorhon et al. (2022) has identified leadership as a key facilitator of innovation which is another input of organizational learning.

- **H3: Barriers have a negative effect on inputs.**

With the same logic of enablers effect on organizational learning, it is hypothesized that barriers have negative effect on inputs. Thus, learning process begins with resources, which listed under inputs component in this thesis, barriers to organizational learning expected to have an effect on inputs. As an example, lack of time, money, and resources for tasks like training and development, communication, and execution are considered as major barriers to organizational learning (Schilling and Kluge, 2009; McCracken, 2005; Sun and Scott, 2005; Zell, 2001; Beer and Eisenstat, 2000).

- **H4: Inputs have a positive effect on impacts.**

Within the scope of this study inputs are considered as the resources of organizational learning, while impacts are considered the effects of organizational learning on corporate level. As companies are learning from the resources and the organizational learning process have impacts on companies, it is hypothesized that inputs have a positive effect on impacts. This relationship has expressed by Cook and Yanow (1993) as organizations grow depending on past experiences and information gathered from outside sources. Similar relationship has also illustrated on the OL framework of Dikmen et al. (2005) where learning sources directs learning and organizational intelligence. In addition, on the framework of Ozorhon et al. (2005) learning resources are depicted as elements of organizational memory which enhances strategic decisions.

- **H5: Inputs have a positive effect on benefits.**

With the same logic of relationship between inputs and impacts, it is hypothesized that inputs have a positive effect on benefits which is described as the effects of organizational learning on project level. It is expected that organizational learning process resources would have a direct positive effect on construction projects. Examples of benefits can be listed as accurate timetables, reduced costs or high-quality final products. According to Dodgson (1993), corporate research and development (R&D) departments serve as important learning resources and are therefore crucial to the survival and profitability of a variety of activities. As an input of OL, R&D-related activities may establish new quality criteria, develop novel technologies, and improve current procedures (Basten and Haamann, 2018).

- **H6: Impacts have a positive effect on benefits.**

In this relationship it is hypothesized that as a positive effect of organizational learning on corporate level impacts have a positive effect on benefits which are on a project level. As an example, Wall and Ahmed (2008) indicated that organizational learning makes completion dates more certain and increases the likelihood that projects will be completed on time and under budget. According to Almaian and Qammaz (2019), understanding and utilizing OL in construction organizations may decrease the detrimental impact of failing to learn from previous projects. In addition, Barlow and Jashapara (1998) stated that OL provides a higher quality product assurance to construction companies.

- **H7: Enablers have a positive effect on impacts.**

As a last relationship, according to literature review it is expected and therefore hypothesized that enablers have a positive effect directly on impacts. Orange et al. (2000) mentioned that as an enabler knowledge sharing mechanisms have a positive effect on learning which enables to share tacit knowledge within the entire organization. In addition, it is mentioned that for long term survival of a company, both the organization and its surroundings must promote the process of group learning (Orange et al., 2000). Organizational learning must be supported with enablers that provide employees a common knowledge of the ways and directions their company must change in order to survive both today and in the future (Kululanga et al., 2001; Baldwin et al., 1997).

3.3. Organizational Learning Levels

The concept of organizational learning has been studied at different levels by different scholars. In this study, the concept was examined by choosing the most suitable levels for the construction industry. Crossan et al. (1999) examined the concept of organizational learning at three levels as individual, group and organizational. Lawrence et al. (2005), Schilling and Kluge (2009) also analyzed the concept at individual, group, and organization levels, based on the work of Crossan et al. (1999). Lähteenmäki et al. (2001) examined the subject at two levels, structural and individual. Dikmen et al. (2005) examined the concept of OL at two ordered levels, first as individual learning and then as organizational intelligence as a result. Schulz (2017) examined learning at three levels as organizational, individual and team learning in his study. Almaian and Qammaz (2019), on the other hand, examined the concept of OL at three levels as individual, project team and organizational in terms of covering all layers in the construction sector. In this thesis, the concept of organizational learning is examined at three levels as individual, project/market and organizational.

The organizational level, made up of top management that determines the organization's strategies and direction, is the basis for the successful execution of OL. Executive management should establish a learning organizational culture, support OL with the necessary time and financial resources, and emphasize the importance of this culture to the entire business with methods that support OL. Project managers and other team members make up the project team level. Project managers should emphasize the value of the lessons learned from each project at this stage and how these lessons can be communicated to other team members and future projects, applied to existing knowledge and processes, and used to prevent similar problems. Organizational staff and temporary team members involved in various initiatives make up the individual level. In order to perform better, these people must apply the principles they have learned to their daily tasks and promote a culture of OL. OL procedures at each level of the organization are summarized in Figure 3.4 by Almaian and Qammaz (2019).

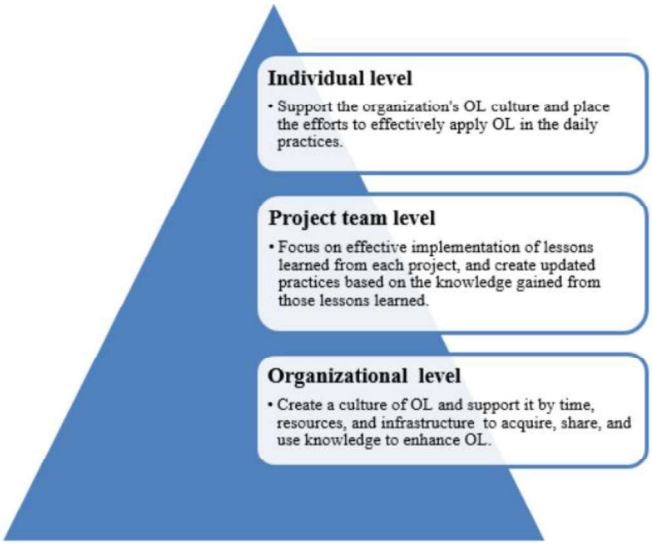

Figure 3.4. OL practices within each level of the organization (Almaian and Qammaz, 2019).

3.4. Components of Organizational Learning

Descriptions of factors affecting organizational learning in the construction industry are presented in this section of the study, along with relevant references. At first, more than 50 articles obtained after the literature review were examined and scanned, and then those factors that were determined to be unrelated to organizational learning in the construction industry were excluded. Some articles were also examined based on the references in other articles during the searching, and these articles along with the factors they contain were also included among the list of articles examined, last article list was for sub-factor scanning includes 48 articles which can be seen in Appendix B Table B.2. The articles have been carefully reviewed and analyzed, and then the indicators and determinants that affect organizational learning are listed. Initially, 133 factors emerged as sub-items of 6 components. Then, the factors of the study were refined by consulting the academic advisor and two professionals working in the construction industry. As a result, the number of factors was reduced to 53. Basically, the reason here is to include semantically overlapping items in common clusters. For example “Change culture”, “Climate of openness”, “Innovation orientation”, “Organizational learning culture”, “Promote inquiry and dialogue”, “Seeking and adopting new management and working approach” , “Knowledge sharing among organizational members”, “Unlearning” factors are gathered under the main title “Embracing the change and innovation culture”. Another purpose of creating this common cluster here

is to avoid the fact that the questionnaire survey study, which will use these factors as a criterion by the construction industry professionals, is too long, bores the participants, and therefore gives biased answers. Based on the literature review, 53 factors found to affect organizational learning in the Turkish construction industry were rated by the construction industry employees in a 1-5 Likert Scale format according to their thoughts and experiences.

3.4.1. Drivers

The driving factors that motivate the companies operating in the construction sector to organizational learning are examined under this title. As a result of 48 academic studies related to the subject from the literature, first 15 drivers were found, and then they were grouped under eight main headings after refinement to make the sector employees rate. Appendix B Table B.1 presents these drivers and related references. Under the eight driver titles, which drivers are gathered under this title, under which level they are related to learning, and detailed explanations are given.

3.3.1.1. Organizational Effectiveness. Under the heading of organizational effectiveness, the subheadings of "organizational performance enhancement", "productivity improving" and "profit improvement" are included and examined. One of the main goals of organizational learning for construction companies is to improve organizational performance in rapidly changing conditions and in an increasingly complex environment. This aim is possible with an organizational level of learning. Schilling and Kluge (2009) define OL as an organizationally orchestrated collective learning process in which individual and group learning experiences relevant to the enhancement of organizational performance. Cook and Yanow (1993) have been empirically shown that when organizational learning capacity increases, company performance also increases. Cheng et al. (2014) emphasized that for the knowledge management to have a significant positive effect on performance, organizational learning is a must.

3.3.1.2. Competitive Advantage. Organizational learning is regarded in the literature as an underlying process for competitive advantage and productivity growth (Ahankoob et al., 2015) which are related with organizational level learning. The role of organizational learning culture in generating competitive advantage was emphasized by Poyner and

Powell's (1995) research of innovation in the UK construction sector (Basten and Haamann, 2018). According to Real et al. (2014), OL is a key component that represents the essence of organizations' competitive advantage (Basten and Haamann, 2018). Cook and Yanow (1993) indicated that learning organizations' achievements highlight the significance of "learning capability" as a key source of competitive advantage. In addition Pheng et al. (2016) stated that Organizational learning (OL) is quickly becoming one of the most significant and long-lasting competitive advantages that may improve business performance.

3.3.1.3. Changes in the Business Environment. If an organization wants to survive, it must learn as quickly as environmental changes. In other words, an organization's capacity for learning determines its ability to adapt to changes in its environment. This learning is related to learning at the organizational level. Organizational learning enables businesses to comprehend and analyze their environment, which aids in better adjusting to changes. In order to adapt to these changes, businesses must create organizational learning capacity when faced with uncertainty and changing surroundings (Jiménez-Jiménez and Sanz-Valle, 2011; Lei et al., 1999; McGill and Slocum, 1993). Similar to this, Wu and Shanley (2009) indicate that businesses find new ideas and acquire new knowledge in dynamic contexts, particularly to stay up with emerging technology advancements (Jiménez-Jiménez and Sanz-Valle, 2011). The effect of organizational learning on performance can thus be enhanced by environmental instability. Innovation must also rely on developing the ability to thrive in circumstances with greater turbulence. In order to adapt to the shifting business environment, it is necessary to scan for new innovations by comprehending the existing reality of business operations (Kululanga et al., 2002).

3.3.1.4. Client Requirements. Another factor that motivates organizational learning is the requirements and demands of clients. If companies want to be successful, grow or maintain their existing business, they must learn according to the needs of their customers. This learning takes place mainly at the project level on behalf of the construction industries. While Barlow and Jashapara (1998) enumerates client requests as one of the main drivers of organizational learning, the relationship between customer satisfaction levels, alliances, and learning has been highlighted by Holt et al. (2000) as well.

3.3.1.5. Government Legislation. One of the main factors that push organizations operating in the construction sector to learn is to comply with government legislation. Regulations, laws and compliances in the sector are often regulated, changed or completely abolished by the authorities for many different reasons. Industry organizations also have to keep up with this situation, and this way they usually learn at the project level. Mandatory organizational learning outcomes include any instances in which an internal or external "threat" results in a change in behavior. For instance, there have been several instances in which building contractors have altered their conduct merely to comply with legal requirements (Kululanga et al., 2001). In addition, according to Barlow and Jashapara (1998), one of the primary forces promoting organizational learning in the construction sector is the use of legislation.

3.3.1.6. Globalisation. Globalization is also a challenge for the construction industry companies and they find themselves learning to adapt to this integrated world. They carry out projects in many unknowns with multinational teams in different geographies. In addition to this, their competitors are not only organizations in their own countries but also all other organizations in the globalizing world. In order to survive in these complex and challenging conditions, they have to learn at the organizational level in order to adapt to globalization. Argote and Miron-Spektor (2011) stated that due to remote work arrangements, globalization, the multiunit organizational structure, and interorganizational linkages including mergers, acquisitions, and alliances, knowledge transfer and learning is also crucial for companies.

3.3.1.7. Sustainability Concerns. Organizational learning is necessary for sustainability implementation in an organization. It is essential to any endeavor to successfully execute sustainable growth inside the company (Siebenhuner and Anold, 2007). In order to fulfill the Brundtland (1987) sustainable development agenda and meet the demands of both present and future generations, organizational level learning is the key strategy (Opoku, 2011; Porter, 2008). Construction companies are in the key position to create a better future because the aspect of the projects are affecting many areas. Organizations should utilize organizational learning in order to minimize the possible social, economic and ecological damages that they may cause to.

3.4.2. Inputs

Inputs title corresponds to where and from which sources companies learn in the organizational learning framework. After examining 48 academic studies on the subject, first 19 entries and then 10 entries after a pre-selection and element combination emerged. These inputs and their corresponding references can be seen in Appendix B Table B.2.

3.3.2.1. One's Own Experiences. This title includes "direct experience", "from contracting experience", "from founder's intention", "learning from previous projects" subtitles. Learning takes place at the organizational level, as the title refers to learning from the experience of all organs of the organization, not just individuals or projects. Barlow and Jashapara (1998), who stated that learning begins with experience, Argote and Miron-Spektor (2011) revealed that after the interviews they conducted as a result of the case studies they examined, the majority of individuals learned substantially from their own work experiences. Cook and Yanow (1993) also highlightes that organizations develop themselves based on prior experiences and data acquired from outside sources. According to Levitt and March (1988) whether the experience was obtained directly by the main organizational unit or indirectly from other units is the most fundamental aspect of the experience. For learning in the construction industry, Cook and Yanow (1993) stated that since the construction industry is project-based, project learning constitutes a large part of organizational learning. Hartmann and Dorée (2015) also summarized as the main purpose of learning between projects in order to avoid the repetition of the same mistakes and problems in construction projects in the next projects (Almaian and Qammaz, 2019).

3.3.2.2. Knowledge Transfer Among Organizational Members. Project-based organizations get knowledge from their "members/teams" as they work to solve challenges; moreover, they can store project knowledge in an organizational stock that will be used as collaborative techniques in the future (Eken et al., 2020; Ozturk et al., 2016; Koskinen, 2012). Additionally, in cross-organizational collaborations, when a number of individuals learn from one another and collectively, learning may instead be advantageous, if not critical to the project's success. In certain instances, the likelihood of the project succeeding without any learning really seems to be rather low (Haapalainen, 2008). Innovating also involves repurposing and using previously acquired information. Employees must exchange

information and expertise to do this. According to Nonaka (1994), innovation happens when staff members share their expertise with the company, and this shared knowledge leads to fresh, open-ended discoveries. Organizational learning, enables the creation, acquisition, transformation, and application of new knowledge that fosters organizational innovation (Jiménez-Jiménez and Sanz-Valle, 2011). Internal knowledge sharing is the utilization of knowledge within an organization through collaborative sharing and cross-functional learning, and at this level it necessitates the usage of essential knowledge assets (Kululanga et al., 2002).

3.3.2.3. Experience of Other Organizations. In today's fiercely competitive construction industry, stakeholders must be able to learn from their business partners and rivals (Ahankoob et al., 2015). As a result of the this environment, many construction companies continue to improve their capacity to adopt novel concepts and absorb knowledge from their surrounding organizations. In the longer-term partnership situations, when customers emphasized the necessity for their partners to take on their “embedded” knowledge, the codifiability of knowledge is a significant determinant (Barlow and Jashapara, 1998). In addition, the building value chain's large number of stakeholders makes “learning from other parties” a crucial problem for OL (Cook and Yanow, 1993).

3.3.2.4. Research and development (R&D). First, businesses can encourage the production of new knowledge, for instance by strengthening their R&D policy and encouraging the trial and development of new ideas within the business (Jiménez-Jiménez and Sanz-Valle, 2011). Dodgson (1993) explained how research and development (R&D) departments of corporations serve as significant learning resources and are therefore essential to the survival and profitability of varied activities, which in turn results in more efficient (Pheng et al., 2016). Independent organizational unit to facilitate the generation of new information, whether through controlled experiments or solitary initiatives to show how new knowledge affects existing tasks. Related efforts might set new quality standards, create new technology, and enhance existing processes (Basten and Haamann, 2018). According to Ozorhon and Oral (2016) the typical metrics used for technology-intensive industries are difficult to capture since construction companies invest less in R&D and instead incorporate new ideas and technologies to improve their operations.

3.3.2.5. Organizational Routines. Although the experience gained in companies over the years is not always codified, these gains can be seen in organizational routines. Rerup and Feldman (2011), for instance, described how routines are learned by trial and error. Explicit routines include an organization's regular operating procedures. Routines can also be tacit, such as those that develop subconsciously as a result of members' adaptations to one another (Argote and Miron-Spektor, 2011; Birnholtz et al., 2007; Nelson and Winter, 1982). When unique insights and abilities are incorporated into organizational routines, practices, and attitudes, OL is facilitated (Eken et al., 2020; Hua and Chan, 2013). To enable learning at higher levels, knowledge of the individuals must be integrated in a non-human repository (transactive memory), such as routines, structures, culture, and strategy (Eken et al., 2020; Ozturk et al., 2016; Vera et al., 2015; King et al., 2008; Love et al., 2000).

3.3.2.6. Learning from Other Stakeholders - Collabrative Working. According to Engeström et al. (1999), co-configuration work is characterized by the development of a complex and adaptive product through the joint efforts of several producers and the client. To enhance the final product, the different stakeholders collaborate closely to share expertise and learn from one another (Bishop et al., 2009). For instance, while designing a hospital, the architect must get input from the future patients' representatives, such as doctors and nurses, on the type of hospital they require and what an ideal hospital should look like (Haapalainen, 2008). On the other side, applying external benchmarking is required when learning from other businesses. Exposure to other working methods can help organizations to enhance their operational procedures because they are often get stuck into their own paradigms (Kululanga et al., 2002).

3.3.2.7. Partners. The idea that strategic partnerships give organizations flexibility and possibilities for innovation and learning certainly appears to be universally recognized (Basten and Haamann, 2018; de Bresson and Amesse, 1991; Harrigan and Newman, 1990; Lewis, 1995; Teece, 1992; 1996). Lavie and Miller (2008) also stated that it is quite common for organizations to learn from alliances. Contractors and suppliers in the construction industry were typically uninformed of the notion prior to their engagement in the project since, in most cases, partnership was recommended by the client (Barlow and Jashapara, 1998). Construction companies can gain knowledge from the successes and failures of their rivals. They can also gain knowledge from long- or short-term (project-based) partnerships

with other businesses, including clients, contractors, suppliers, etc., in order to benefit from their practices, knowledge, and perspectives (Ozorhon et al., 2005).

3.3.2.8. Rules and Regulations. Another non-explicit form of keeping knowledge within companies is rules and regulations as well as routines. When companies examine the existing rules and regulations of their own or other organizations around them, they will discover an important resource for learning. In addition to this resource, standards published by government authorities are also can be an important resource for learning.

3.3.2.9. Acquiring and Grafting New Members. Especially in companies that do not have a systematic knowledge management or organizational learning process, knowledge is kept by the individuals who make up the company as information. Another important source of learning is recruiting and training employees with this knowledge from other departments, companies or sectors. Another method for sharing knowledge is to move individuals across organizational units (Kane et al., 2005). Similar to this, knowledge may be transferred by shifting tools from one unit to another since knowledge can be encoded in tools (Argote and Miron-Spektor, 2011).

3.3.2.10. Trade Shows and Exhibitions. Finally, important sources of knowledge gain for organizations are sectoral fairs, seminars and exhibitions. Jiménez-Jiménez and Sanz-Valle (2011) also stated that ensuring that employees regularly attend fairs and exhibitions promotes the acquisition of new knowledge.

3.4.3. Enablers

Under the title of Enablers, factors that facilitate organizational learning and accelerate the process are defined for companies. After 48 academic studies were examined and analyzed, 36 enabler items were listed first, and then they were reduced to 10 items by clustering to get the construction sector employees to rate. Appendix B Table B.3 shows the listed enabler factors and their corresponding reference sources.

3.3.3.1. Embracing the Change and Innovation Culture. Individuals must actively acquire knowledge and adapt their behavior in response, but it is crucial for an organization that the

organization and its environment support the process of collective learning (Orange et al., 2000) and embrace the innovation culture. Additionally, several scholars have emphasized the significance of organizational culture as a learning facilitator and the strategic perspective required to integrate OL as a part of culture (Cook and Yanow, 1993; Robinson, 2005; Huemer and Ostergen, 2000). Senge (1990) outlined many tactics for fostering an organizational learning culture, including strengthening teamwork abilities, fostering multicultural and global mindsets, and altering one's perspective on learning. Organizational learning may be considered to be ingrained into the culture of the company if it does so via promoting training, encouraging staff to submit new ideas, rewarding greater learning, and other similar actions (Dikmen et al., 2005).

3.3.3.2. Knowledge Sharing Mechanisms. Supporting information sharing systems and increasing their investments is critical for organizational learning, because companies do not know who has the knowledge they need, how to share this knowledge, how to benefit from this knowledge. Especially today, although recording has become easier with advanced technologies, it is still a mystery how the recorded data will be processed and shared. Through improved information management and the development of collaborative learning environments, technological and IT advancements promise to enhance and transform conventional stakeholder interactions in construction sector (Ahankoob et al., 2015; Yang et al., 2012).

The focus of knowledge management should be on how to retain information and make it accessible to all employees who could find it useful in coming up with solutions for various issue settings, as indicated by Haapalainen (2008). It is important to share the tacit knowledge that is kept in the brains of an organization's “experts” with the rest of the organization rather than keeping it to themselves in order for organizations to learn (Orange et al., 2000). While knowledge transfer is a crucial aspect of organizational existence, the mechanisms that allow it plays a critical role in organizational survival.

3.3.3.3. Coordination and Integration Among Stakeholders. Coordination and integration between organizational departments and production process parties is of critical importance, as the knowledge is kept by different units and individuals and a benefit can be obtained from its sharing. The findings of the preliminary analysis of OL in the construction sector

demonstrate the significance of developing an organizational culture (at the organizational level) that supports OL use (Almaian and Qammaz, 2019). According to Crisp (1995), sector might be more innovative if clients were more actively involved in research, there was a culture of innovation, and there were better mechanisms to acquire knowledge.

3.3.3.4. Top Management – Leader Support. A fundamental aspect of knowledge management and learning is the concept of leadership (Stata, 1989). Knowledge management calls for a positive shift, and leadership should act as its catalyst and leadership is really an expression of a vision, not just a style exercise (Kululanga and McCaffer, 2001). A key facilitator of innovation has been identified as effective leadership (Ozorhon et al., 2022; Ozorhon et al., 2010; Tatum, 1987). It is a moral act that proclaims an organization's future vision and the intellectual zeal to persuade people to adopt a knowledge-based culture. As a result, the leader must motivate the entire organization in order to change the culture of knowledge management. In construction sector, project managers hold a crucial function in organizational learning, according to Haapalainen (2008). Transformational leadership seems to require vision, and having vision presumes that the leader is aware of the organization's essential principles, goals, and objectives (Kurland et al., 2010).

3.3.3.5. Goal Clarity - Shared Vision. According to Baldwin et al. (1997), conditions that provide employees a shared understanding of how and which direction their organization must change in order to exist both now and in the future are necessary for organizational learning to take place (Kululanga et al., 2001). A vital component of organizational learning is a shared vision (Kurland et al., 2010; Johnson, 2002; Bass, 2000; Senge, 1990). For learning organizations, having the capacity to develop a shared future vision with other members of the company appears to be essential.

3.3.3.6. Encouraging Personal Skills and Involvement. Employers in the construction industry face a difficulty in attracting or training workers who are interested in knowledge production and in providing them with the right support systems to advance knowledge management (Kululanga and McCaffer, 2001). But creating such a knowledge management culture is not something that happens by accident. It entails the organization's and every employee's intentional behaviors. A culture inside a business that enables employees' freedom to inquire and participate through constructive criticism is referred to as a “climate

of openness" and his in turn fosters trust, which inspires innovation and liberates staff members from fear and hesitancy (Kululanga et al., 2002). In addition, individual creativity has been shown to be enhanced by drive to get rewards (i.e., promotion emphasis), but it has been found to be inhibited by motivation to avert penalties (i.e., prevention focus) (Argote and Miron-Spektor, 2011; Friedman and Forster, 2001, Kark and Van Dijk, 2007).

3.3.3.7. Education for Individual and Organization. Alwani-Starr (1997) highlighted the significance of individual training and learning as facilitators of organizational learning (Cook and Yanow, 1993). Quick and efficient use of the organizational learning is made possible by a basic training and workshop package and a self-learning package (Kumaraswamy, 2006). Individual training is a key focus for the majority of businesses in the sector. Many businesses provide advanced training programs, and training curricula frequently correlate with acceptable performance and skill levels (Murray, 2003). Continuous professional development (CPD) and lifelong learning are essential to the development of both individuals and organizations (Browell, 2000). Formal CPD typically takes one of the following forms: internal and external training courses, post-graduate academic studies like diplomas and master's degrees, attending pertinent technical lectures, presenting a technical paper or preparing a report, taking part in technical conferences or study trips, and special exam leaves (Wall and Ahmed, 2008).

3.3.3.8. Feedback mechanisms. Feedback is the "main key" and the most crucial learning concept, according to Drucker (1992). However, the most crucial element in this situation is that people should wish to formally share their experiences while also attending to their vital daily obligations (Orange et al., 2000). Measuring business processes entails a corporation determining its organizational learning by quantitative and/or qualitative evaluation of its business processes in order to give timely feedback on its improvement realized. In order to deliver knowledge-based services, it is advised that businesses hire knowledge employees who can use their expertise to find answers and provide feedback (Almaian and Qammaz, 2019; Chinowsky et al., 2007).

3.3.3.9. Partners - Collaborative Working. Companies may improve and develop new skills and inventions in a more regulated and low-risk environment thanks to partnerships. Therefore, maintaining the same staff from project to project in long-term partnership

arrangements could provide “learning” advantages (Barlow and Jashapara, 1998). A more widespread use of “partnering” or cooperative connections between customers, contractors, subcontractors, and suppliers, would enable the construction sector to be more innovative, according to Latham (1994). There is proof that cooperative connections foster the development of novel products and procedures (Barlow and Jashapara, 1998; Shaw, 1994; Dodgson and Rothwell, 1994). The importance of networking was emphasized by Hakansson et al. (1999), who noted that it offers a significant chance for learning for all participants. Similar to this, Orange et al. (2000) recognized collaboration as a learning facilitator and recommended a virtual collaborative environment to improve project learning.

3.3.3.10. Heterogeneous Experience. It has been discovered that heterogeneous experience increases learning results more than homogenous experience (Argote and Miron-Spektor, 2011; Haunschild and Sullivan, 2002; Schilling et al., 2003). The point underlined here is that the diversity of experience gained over the years will enable more efficient operations in the years to come. Some researchers in the literature have also mentioned the positive relationship between the age of the company and therefore the excess of experience with performance. Firm age has an impact on organizational learning and performance (Jiménez-Jiménez and Sanz-Valle, 2011; Aiken and Hage, 1971; Hitt et al., 1997; Pierce and Delbecq, 1977; Sorensen and Stuart, 2000). According to Sorensen and Stuart (2000), organizations benefit from the expertise and organizational skills that aging brings, which enables them to improve their operations, including those connected to innovation, more effectively (Jiménez-Jiménez and Sanz-Valle, 2011).

3.4.4. Barriers

The processes that undermine, obstruct, and repress OL have been the subject of an increasing number of articles (Schilling and Kluge, 2009; Bain, 1998; Berthoin-Antal et al., 2003; Kim, 1993; Nason, 1994; Tucker et al., 2002). In this section, the barriers to organizational learning for companies operating in the construction sector are examined. As a result of the detailed examination and analysis of 48 academic studies, there were 44 obstacles at first, then it was reduced to 12 by clustering. The barriers listed in Appendix B Table B.4 and related reference sources are indicated.

3.3.4.1. Lack of Participation and Communication. Many companies gather experiences at the individual level rather than at the corporate level (Barlow and Jashapara, 1998). Burnes (2003) recognized the importance of employee engagement in identifying the need for change and carrying it through. However, since each project and its difficulties are unique in the construction sector, each person's tacit knowledge consists of the particular answers to each project's problems. Due to the ephemeral nature of building projects, the construction sector also has supply chains and connections that are both dynamic and transient, leading to a weak communication structure (Orange et al., 2000) which prevents organizations to learn.

3.3.4.2. Lack of Organizational Structure and Culture. The transient nature of project teams and the employees' transition from team to team and/or project to project are one of the main obstacles against organizational learning in the construction industry (Almaian and Qammaz, 2019). A new team is often established for each product by the team responsible for delivering a building project. As a result, learning and feedback loops are frequently interrupted (Gann and Salter, 2000), which makes it challenging to achieve long-term learning curves in the construction industry (Senaratne and Malewana, 2011). Orange et al. (1999) described this phenomena by stating that employees do not always share their experience and knowledge with their coworkers as they move from team to team within a company. Daily observations demonstrate that staff turnover results in a significant loss of the human components of an organization's memory (Huber, 1991). Many organizations firmly believe that the primary “goal” of working on a construction project is to secure a profit at the cost of others rather than to contribute to the project's completion (Bishop et al., 2009). Which causes stakeholder conflicts to be of interest. Moreover, problems with languages and national cultures have been shown to prevent companies from learning, according to Kuznetsov and Yakavenka (2005).

3.3.4.3. Lack of Innovation Culture. The construction industry is often criticized in the literature for being closed to change, not keeping up with up-to-date implications and not adopting the innovation culture. According to Kale and Arditi (2003), one of the key causes of this is that most of the advantages of OL show off with time. Therefore, OL effects show their benefits over a long period of time and require stability (Cook and Yanow, 1993). Aside from that, structural and organizational restrictions mostly limit the degrees of flexibility for

“thinking outside the box” or acquiring new ideas by either having too much (for example, since there aren't any clear, measurable goals) or too little freedom (e.g owing to limited job definitions, strict policies, and corporate identity) (Schilling and Kluge,2009). As another reason, Levitt and March (1988) defines companies' successful performance for a long time as “competence traps”. The three most significant personal obstacles, according to Quinn Patton (1990), are fear of uncertainty, fear of humiliation, and fear of being held accountable (Vakola and Rezgui, 2000).

3.3.4.4. Complex and Changing Environment. Organizational learning is crucial to increase strategic flexibility and response to environmental changes since organizations operate in an increasingly complex and dynamic environment (Zhai et al., 2013; Zahra and George 2002; Sirmon, 2007). According to Groak (1994), the construction sector is a field of projects with intricate adaptive qualities that are positioned in a chaotic environment (Barlow and Jashapara, 1998). Construction is a complicated industry that involves several knowledge-driven activities and commercial interests among participating entities. The relevant parties use a wide range of organizational and technical procedures. Construction companies use a number of models and metrics to analyze their performance in order to evaluate the attainment of goals and determine their efficiency and effectiveness (Zhai et al., 2013) which makes organizational learning even more challenging.

3.3.4.5. Fragmented Nature of the Industry. One of the challenges for OL in the construction sector is connected to team participation throughout the project life cycle. The fragmented character of the business hinders learning and causes hurdles to the effective absorption of knowledge (Ahankoob et al., 2015). Throughout the course of the project, the team's size and makeup change (Orange et al., 1999). As a result of this transition, social networks that encourage information sharing fail, dissipating both individual and communal knowledge (Orange et al., 1999; Cherns and Bryant, 1984). The majority of companies in this sector are small, and production is frequently structured into hierarchical chains of players that are bound together by excessively onerous contract clauses (Barlow and Jashapara, 1998). The knowledge needs to be transformed into organizational knowledge is critical (Zin and Egbu, 2009) due to the nature of building projects, specifically taking into account changes in project sites and teams (Eken et al., 2020).

3.3.4.6. Rigid and Outdated Core Beliefs, Applications. In the construction industry, strict departmental divisions, large, unmanageable organizations, and bureaucracy impede learning, whereas adaptability, openness, freedom, and opportunity foster it (Dikmen et al., 2005; Marquardt, 1996). Numerous studies have shown a nonlinear link between experience and creativity or innovation: up until a certain point, experience increases both traits, with declining benefits at higher experience levels (Argote and Miron-Spektor, 2011; Hirst et al., 2009; Katila and Ahuja, 2002). This is related to the tendency of long-term successful enterprises to block off to innovation and form inflexible convictions. Additionally, organizational routines lead to social systems' predisposition toward stagnation or dynamic conservatism, which is a resistance to change (Kululanga et al., 2001).

3.3.4.7. Lack of Top Management Support. The absence of support from senior management to get the necessary resources for OL implementation is one of the main obstacles to OL. Additionally, the staff is unable to create a culture of learning due to the absence of assistance (Almaian and Qammaz, 2019; Chinowsky et al., 2007). A leader who is committed to learning promotes organizational learning by starting a procedure through which other staff members may get a comparable awareness and knowledge to encourage progress (Kululanga et al., 2002). It is crucial for a learning organization to prioritize helping individuals “embrace change” as one of its guiding principles (Senge et al., 1994). It needs a commitment to developing the relevant abilities across the company since it does not happen naturally (Kurland et al., 2010). Instead than using a structured set of tools and data that might assist comprehend the problem, managers typically depend more on their intuition and experience when making decisions and addressing problems (Lantelme and Formoso, 2000). Four of the eight businesses state that OL is hindered by the type of leadership, corporate management style, and lack of professional management (Ozorhon et al., 2005).

3.3.4.8. Ambigous Goals. One of the primary barriers against of organizational learning is the absence of defined, quantifiable goals and performance feedback (Schilling and Kluge, 2009). According to Godkin and Montano (1991), another hurdle is the inconsistency between the innovation's original intentions and the success criteria used to assess it. Having a shared understanding of the course that a firm must pursue in order to exist in the future is necessary for creating a shared vision. It encourages systematic organizational learning and ongoing search for improved working practices (Kululanga et al., 2002).

3.3.4.9. Lack of Resources.

One of the biggest obstacles to organizational learning is a lack of time, money, and resources for activities like training and development, communication, and implementation (Schilling and Kluge, 2009; McCracken, 2005; Sun and Scott, 2005; Zell, 2001; Beer and Eisenstat, 2000) The lack of money to invest in learning organization programs and the lack of time to devote to acquiring new knowledge were both mentioned by Chinowsky et al. (2007) as obstacles to OL. Managers have identified the lack of resources of people and time as the primary barriers to adopting organizational learning measures (Lantelme and Formoso, 2000; Lantelme, 1994).

3.3.4.10. Lack of Structured Framework for Learning. Due to a lack of a defined framework for conducting project evaluations, contractors miss out on some of the most important lessons that could have been learnt from them. Even if the business environment in the construction sector has begun to modernize some of its operational procedures, the industry continues to suffer from needless loss of knowledge (Kululanga et al., 2001). According to Lindner and Wald (2011), team members' expertise gained during building projects is not always accurately recorded and shared. An obstacle to OL in the construction sector is the absence of an infrastructure to promote knowledge exchange among employees with the aim of fostering a learning community (Almaian and Qammaz, 2019). At the conclusion of a project, knowledge loss and the ensuing organizational amnesia pose the biggest danger to construction organizations (Cook and Yanow, 1993).

3.3.4.11. Lack of Knowledge to Implement Innovation. Innovation applications require a certain experience, resources and knowledge. However, as Barlow and Jashapara (1998) noted, many organizations in the industry are quite young. In addition, deficiencies in innovation practices are observed due to lack of knowledge, considering the lack of resources and temporary teams throughout project life.

3.3.4.12. Lack of Well-trained Human Resources in the Sector. Since the construction industry is a project-based industry, the teams established are mostly limited to the life of the project. For this reason, it is very difficult to train manpower, transfer the learned knowledge to the next project, and establish a systematic innovation process. Zhao and Shen

(2008) point out that one major issue for Chinese contractors competing on the global market is a shortage of skilled human resources (Zhai et al., 2013) However, the primary issues with HR management for Chinese construction businesses have been identified as being: stagnant personnel management, high employee turnover, rigid work structures, a lack of effective motivating rewards, and poor training program efficacy (Zhai et al., 2013; Ma, 2005; Song, 2004; Zeng, 2004). Organizations may get the incorrect conclusions from experience and come up with the wrong outcomes (Zollo and Reuer, 2010, Tripsas and Gavetti 2000). The term "superstitious learning" was created by Levitt and March (1988) to characterize the incorrect lessons that organizations learn.

3.4.5. Impacts

Under the heading Impacts, the effects of organizational learning on the construction industry companies at the corporate level are stated. By examining and analyzing 48 academic studies, initially 13 and then seven impacts by clustering were listed to be rated by the construction industry authorities. The impacts and related reference sources mentioned in Appendix B Table B.5 are also seen.

3.3.5.1. Competitive Advantage. One of the most common statements in the literature regarding with organizational learning is that it is a prerequisite or most important factor for competitive advantage. Numerous studies have examined the possible role of organizational learning as a source of competitiveness (Senaratne and Malewana, 2011) as a result of the increased popularity of this concept among business professionals since the 1990s (Styhre et al., 2004). The role of organizational culture in generating competitive advantage was emphasized by Poyner and Powell's (1995) research of innovation in the UK construction sector. According to Real et al. (2014), the organizational learning is the key to understanding what makes a company competitive.

3.3.5.2. Integration of Business Processes and Participants. Another major challenge for construction industry projects is the integration of a multi-team structure and a multi-stage workflow plan. Many technological innovations in the sector have also targeted this subject, companies also have to learn to benefit from these tools organizationally. The technological features of BIM may be used by companies to create a more open working environment.

Participants are more driven to exchange expertise and pick up tips from partners in an open environment (Ahankoob et al., 2015; Lipshitz et al., 2002). Exchange of information and striking a compromise become less stressful when each partner has a thorough grasp of the requirements of the other (Nyström, 2005). Businesses may improve the integration of project processes and participants by utilizing BIM's technological qualities. An integrated database system is said to enhance the sharing of operational information across supply chain participants (Shang, 2009).

3.3.5.3. Enhance Decision-making Abilities. OL encourages contemplation on the effects of behavior on individuals and organizations, greater comprehension of organizational contexts, and better decision-making (Bishop et al., 2009; Yang, 2007). Organizational memory may be efficiently used by construction companies to improve decision-making. It is suggested to employ decision support systems (DSS), which integrate analytical techniques with expert judgment. It is suggested that OM is a significant asset that has to be developed and utilized in order to support trustworthy company choices. Making more strategic decisions will be easier if the memory's codified component is improved (Ozorhon et al., 2005).

3.3.5.4. Organizational Effectiveness. There is evidence to suggest that a firm's capacity to adapt to its changing environment and, by extension, its level of learning is related to its competitive performance (Barlow and Jashapara, 1998). Learning orientation has a direct impact on organizational performance, according to Baker and Sinkula (1999). According to Murray and Chapman's (2003) questionnaire survey results, an organization's performance on building projects is favorably correlated with its learning abilities (Wong et al., 2012). Given that organizational learning is so crucial to organizations and their prosperity, a deeper understanding of organizational learning promises to both advance organization theory and contribute to better organizational practice. Research suggests, perhaps unsurprisingly, that the dominant learning focus among most players in the case studies was on efficiency improvement (Argote and Miron-Spektor, 2011).

3.3.5.5. Achieving Budget Goal. Another organizational-level effect of organizational learning is that it helps to change known, ongoing, and unintentionally repeated mistakes. When organizational performance is measured in terms of achieving the firm's intended

profit and the developer's expectations on project cost, in particular, the influence is discovered to be more substantial (Wong et al., 2012). With the help of “unlearning” in organizational learning, it is a very efficient application in reaching the budget targets of the company.

3.3.5.6. Adaptation to Changing Environment. Another fundamental feature of the construction industry is unpredictability. Since there is no workflow in an environment where conditions are completely under control, and it is a complex, multi-step workflow structure, uncertainties are constantly being struggled with. In this field, construction companies make a lot of investment and research in order to increase their predictability. For businesses working in unstable conditions, OL is essential for them to react to unanticipated occurrences faster than their rivals (Basten and Haamann, 2018; Garvin et al., 2008). Sustained competitive advantage depends not only on the nature of resources at a given time but also on companies capacity to be continuously replenished, assigned, and redefined in response to environmental changes.

3.3.5.7. Innovation Capability Improvement. According to several authors, organizational learning enables businesses to build capabilities that foster creativity, and innovation is what has a beneficial impact on performance (Jiménez-Jiménez and Sanz-Valle, 2011; Baker and Sinkula, 1999, 2002; Han et al., 1998; Hurley and Hult, 1998). In order to encourage continuous learning and innovation, organizations pursuing effective OL adoption should develop a supporting culture of management values, attitudes, and commitments (Almaian and Qammaz, 2019).

3.4.6. Benefits

Under the title of Benefits, the issue of how construction companies benefits from organizational learning at the project level has been researched and examined. By examining and analyzing 48 academic studies, initially eight benefits were listed, and then six benefits were listed in the final version to be rated by construction industry professionals. Appendix B Table B.6 shows the listed benefits and related literature resources.

3.3.6.1. Accurate Cost Estimates. Organizations frequently carry out several initiatives at once, and the majority of the time they move quickly from one to the next without reflecting on their mistakes. As a result of having the same issues in every project, several quality and cost overrun issues arise. The negative effects of failing to learn from prior projects may be lessened with the understanding and use of OL in the construction companies. In parallel with this learning, companies can obtain more consistent results in cost calculations, and even small consistency can provide enormous profits when the cost of projects is taken into account.

3.3.6.2. Reduced Costs. Another benefit of organizational learning in the construction industry is that the cost of future projects can be reduced by learning from past experiences. Furthermore, Pheng et al. (2016) discovered that organizational learning in BIM and Buildable Design Appraisal System (BDAS) leads to a drop in construction costs. Love and Josephson (2004) discovered that contractors that are able to actively learn from experience can achieve project cost savings based on case studies of building projects in Sweden (Wong et al., 2012).

3.3.6.3. Accurate Timetables. Budgets are exceeded, schedules are inaccurate, and end-user demands are not satisfied are just a few of the issues that have been recognized as being caused, among other things, by a lack of knowledge management and information sharing in the construction sector (Haapalainen, 2008; Naaranoja and Uden, 2007; Anumba et al., 2005; Love et al., 2004). The realization that learning and training are essential components in carrying out major building projects has been a primary impetus in resolving the problems mentioned in many of these studies. As a result of learning, completion dates are more assured and there is a higher chance that projects will be finished on time and on budget (Wall and Ahmed, 2008).

3.3.6.4. Reduced Time. One of the most common problems seen in construction projects is the inability to comply with the prepared initial timetables, and the delay of the projects sometimes for years, as in common examples. Additionally, it was discovered by Pheng et al. (2016) that organizational learning in Workforce Training and Upgrading (WTU) scheme, BIM, BDAS, and Constructability Appraisal System (CAS) resulted in a reduction

in construction time, which implies that advancements in OL techniques in WTU, BIM, BDAS, and CAS would result in a reduction in construction time.

3.3.6.5. High Quality of Final Product. Organizations in construction sector typically carry out several proejcts at once, and they frequently jump from one to the next without taking any lessons from mistakes made in the past. As a result of having the same issues in every project, several quality and cost overrun issues arise. The negative effects of failing to learn from prior projects may be lessened with the understanding and use of OL in the construction companies (Almaian and Qammaz, 2019). As a result of organizational learning activities, higher quality, more satisfying final products can be produced. According to Barlow and Jashapara (1998) OL enables construction companies to move towards quality assurance.

3.3.6.6. Enhanced Construction Productivity. Construction companies must continually increase their efficiency if they want to maintain their competitiveness and reduce their reliance on foreign sources. One of the most important and lasting competitive advantages for increasing productivity is organizational learning (Guthrie, 2005; Levitt and March, 1988). In order to investigate the relationship between OL and productivity in the construction industry, Pheng et al. (2016) collected quantitative data through a survey questionnaire given to contractors in Singapore and discovered that there is a strong correlation between the breadth of OL practices and the level of productivity in the industry. This productivity is primarily measured by the decrease in construction time, which is attributable to certain organizational learning applications, and the decrease in construction cost, which is attributable to other organizational learning implications.

3.5. Questionnaire Survey

In order to gather data from a large number of respondents, a questionnaire survey is a sort of research tool that consists of a list of questions or other prompts. Questionnaire replies are often simple to tabulate or score, and the accompanying data are simple to analyze, especially if the questionnaires mostly consist of check-box items, which is advised (Patten, 2016).

Within the scope of this thesis study, a questionnaire survey was prepared in order to collect data to measure hypothesized relations in the proposed conceptual model. The questions were prepared on the basis of a 5-point Likert scale, with 1 indicating the least impact and 5 indicating the most impact. The survey study consists of three parts. In the first part, there are survey questions to determine general information such as the role of the employees in the company and the type of the company, in the second part there are definitions and summary information about organizational learning, in the third part there are questions prepared to measure the approaches of the construction industry companies in Turkey to the subject of organizational learning. In terms of the reliability of the study, the participants were asked to please tick the most appropriate option that reflects your experiences and thoughts about the company you work for.

In order to test whether the survey is easy to understand in accordance with its purpose, it was first presented to the thesis advisor, feedback was received, and then it was presented as a pilot study to four professionals from the sector. Two of these four professionals are civil engineers, one is a mechanical engineer and one is an architect, and they all work in large-scale companies in the construction sector in Turkey. After this pilot study, some wording changes were made in the questions to make the questions more understandable and a framework figure was added to the survey pages.

Questionnaire survey was submitted to Boğaziçi University ethics committee for approval, and the distribution was started after the necessary approval was obtained. Since organizational learning concept concerns all units and individuals in companies, it was aimed to deliver the survey to all levels of employees who are aware of the general situation in their companies and sector. The target group listed included each group such as executives, mid-level managers, engineers, architects, technicians from several architecture, engineering and construction (AEC) companies.

The study was sent to the target group via an e-mail containing a questionnaire survey participation link. The list of participants here was created among the employees of the member companies of the Turkish Contractors Association (TCA) and Institution of Civil Engineers. In addition to e-mails, the target group was reached via Linked-in, a professional network, in order to increase the participation rate. In addition, the Institution of Civil

Engineers shared the survey in its member group on Facebook, a social media network. Although it is not possible to be sure exactly how much of the e-mails sent reach the respondents, it is calculated that approximately 2500 e-mails have been sent. A total of 140 responses were received from 2500 e-mails sent in total and 100 employees who were contacted via direct message via Linked-in, which equals to response rate of 5.4%. The sample questionnaire survey can be seen at Appendix A.

3.6. Statistical Analysis Methods

To organize and explain the features or components of a specific sample, descriptive statistics utilize numerical or graphical methods. Often referred to as a measure of central tendency, descriptive statistics seek to define the middle of a score distribution as well as the scatter, or variance of the scores. Within the scope of this study Microsoft Excel and Statistical software package SPSS version 26.0 were used in order to analyze through calculating descriptive statistics of the data collected.

It is crucial to thoroughly analyze the various levels of measurement before focusing on descriptive statistics in particular since certain statistical approaches are only applicable to specific levels of measurement. The level of measurement is frequently the first consideration when choosing which statistical techniques to use. The grading of instances and participants into broad groups constitutes the nominal (or categorical) measure level. Fisher and Marshall (2009) explained the examples of nominal measure level usage with gender categorization. For instance, you could be curious to know how men and women differ in terms of their health results. For the “gender” variable, each sample participant would have to be scored in one of the two categories, male or female (factor). Here the most important part is including all possible answers into given options. Of course, one point that should not be forgotten or added is that there are not only two genders. The important point here is that all categories should be added as options or have “other” choice so that there is no uncertainty or gap. In addition Fisher and Marshall (2009) explained ordinal measurement level as the scoring of study participants in hierarchically arranged categories is known as the ordinal measurement level. For elements like pain, pleasure, or worry that cannot be readily assessed, the rank level is employed. Numerical categories with Likert-type scales are ranked from low to high.

In the framework presented, there are theoretical constructs, the observed indicators that make them up, and the relationship between constructs. Within the scope of the thesis, it is desired to test these theoretical relations and structure through statistical methods. For this, different techniques were examined and it was decided that the most appropriate one for the presented framework was structural equation modeling (SEM) because SEM is frequently used to evaluate data like this that has a lot of different variables and constructs. Researchers may quickly make up and accurately assess fictitious links between theoretical constructs as well as those between the constructs and their observable indications using SEM when there are enough participants.

3.6.1. Descriptive Statistics

Within the conducted questionnaire survey five-point Likert scale used to assess the given importance to the regarding factors of organizational learning. Then, according to the results obtained, analysis is performed by using descriptive statistics such as population distribution percentage, mean, median, standard deviation, variance, mean. In addition to these, statistics methods such as Cronbach's alpha, kurtosis and skewness are used to measure the distribution, reliability and normality of the sample population. The statistics analysis methods and details used in this study are explained in detail in the following paragraphs.

Chen (2022) describes skewness as a deviation from a symmetrical bell curve or normal distribution in a collection of data. A curve is defined as a line that has a left or right shift. A distribution's skewness may be calculated as a representation of how far it deviates from a normal distribution. While a lognormal distribution, for instance, will have some right skew, a normal distribution has zero curvature. Skews and distributions come in a variety of forms. Both positive and negative skewness have an impact on the “tail” or collection of data points that are distant from the median. A longer or thicker tail on the left side of the distribution is referred to as negative skew, whereas a longer or thicker tail on the right is referred to as positive skew. The direction or weight of the distribution is indicated by these two skews. Additionally, a distribution's skewness might be zero. A data graph has zero skewness when it is symmetrical. Zero skewness denotes the normal distribution of the data,

regardless of how long or thick the distribution tails are. If a dataset does not include enough details on the distribution of the data, it may potentially have an undefined skewness. Skewed and normal distrubiton examples on the graph can be seen in Figure 3.5.

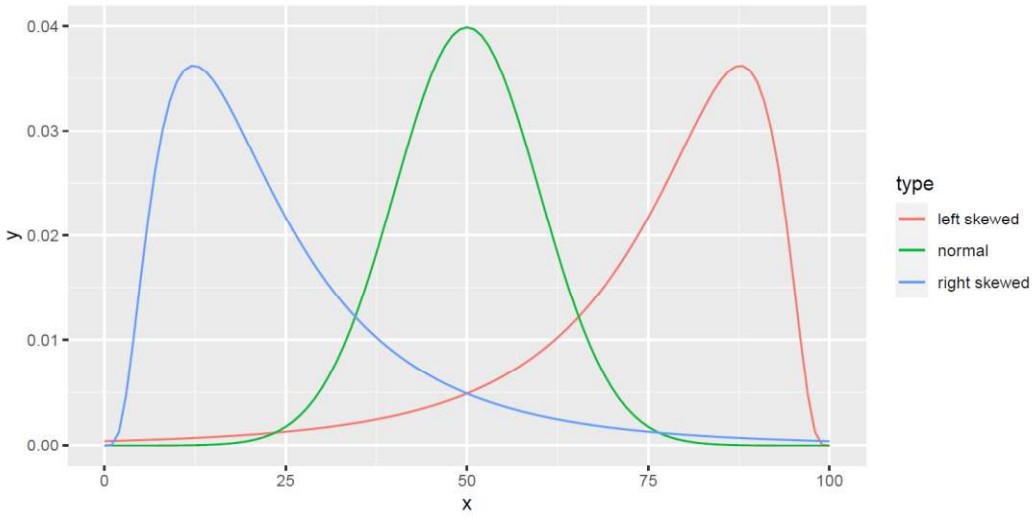

Figure 3.5. Skewed and normal distribution examples.

Kurtosis is a statistical term used to define the distribution, similar to skewness. Kenton (2022) explains the difference of kurtosis as it counts outliers in both tails while skewness distinguishes outliers in one tail from the other. Data from distributions with high kurtosis show tails that are longer than those of the normal distribution (eg, five or more standard deviations from the mean). Less extreme data tend to be present in distributions with low kurtosis than in the normal distribution's tails. In the Figure 3.6, example graph of positive, negative kurtosis and normal distribution can be seen.

The concepts of kurtosis and skewness are often compared with normal distribution in the literature. Many researchers interpret the closeness of the collected data to the normal distribution or whether there is a normal distribution by looking at the skewness and kurtosis values. Here, the normal distribution range in the literature varies for many researchers. To demonstrate a normal univariate distribution, values for asymmetry and kurtosis between -2 and +2 are regarded acceptable (George and Mallery, 2010). According to Hair et al. (2006) and Bryne (2010), data is regarded as normal if the skewness and kurtosis are within a range of 2 to +2 and 7 to +7, respectively. According to Hoyle (2012), univariate normality is a

case indicated by skewness and kurtosis values more than 2 and 7, respectively. According to Kline (2011) kurtosis greater than 10 is also highly troublesome.

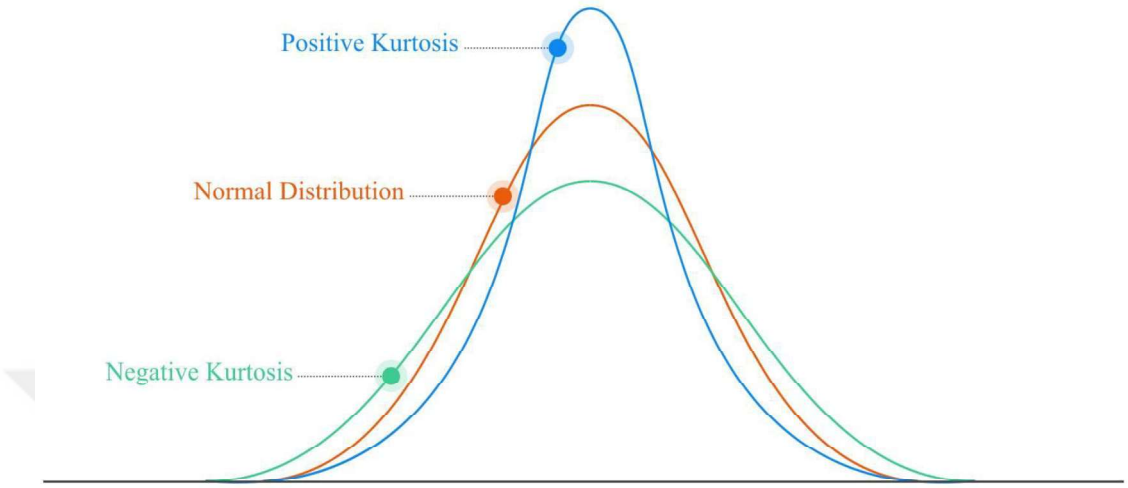

Figure 3.6. Example of positive, negative kurtosis and normal distribution.

In statistics, in addition to the mode and the median, the mean is one of the measures of central tendency. The average of a set of variables is all that the mean is. It displays the values' uniform distribution for the specified dataset. Three often used metrics of central tendency are mean, median, and mode. The total values shown on the datasheet must be added together, and the mean must be calculated by dividing the total by the total number of values. When all values are sorted in ascending order, the median is the median of the provided data. In the list, mode appears the most frequently. In this study mean ranking has used in order to calculate each factor's significance and compare them with each other. The formula of mean ranking is given as:

$$\text{Mean} = \frac{\sum_{i=1}^{5} iN_i}{\sum_{i=1}^{5} N_i} \tag{3.1}$$

A measure of internal consistency, or how tightly a set of items are connected as a group, can evaluate by Cronbach's alpha, which was proposed by Cronbach (1951). It is used as a gauge for the dependability of scales. To determine the reliability of multiple-question surveys using the Likert scale, Cronbach's alpha tests can be used. These inquiries assess latent variables, which are hidden or unobservable traits like neurosis, openness, or

conscientiousness. In the actual world, it is quite challenging to quantify them. It can determined how closely a set of test items are connected to one another using Cronbach's alpha values. Values are ranging between 0-1 and in general values higher than 0.70 regarded as acceptable for many authors. In the program SPSS cronbach's alpha formula is given as:

$$\alpha = \frac{N\bar{c}}{\bar{v}+(N-1)\bar{c}} \tag{3.2}$$

Where N is equal to the number of items, $\bar{c}$ is the average inter-item covariance among the items and $\bar{v}$ equals the average variance.

3.6.2. Structural Equation Modeling (SEM)

According to Hoyle (2012) structural equation modeling (SEM) is a expanding family of statistical techniques for simulating interactions between variables.Although these correlations are anticipated and modelled using observable data, models may also include latent or unobserved factors. SEM is also known as latent variable modeling because of this. Covariances serve as the main input for the majority of SEM applications, which explains why SEM is also known as covariance structure modeling. And this explains why SEM is occasionally referred to as causal modeling and why many applications of SEM aim to anticipate causal effects between variables.

SEM is connected to more specialized and well-known statistical models like analysis of variance, multiple regression analysis, and principal factor analysis since it uses a linear model to account for correlations between variables. In fact, SEM may be used to conduct any of these analyses and provide the same outcomes. The generalization, integration, and extension of these well-known models are what SEM is, thus.

The conventional method for combining multiple regression analysis and factor analysis entails factoring one or more predictors and a set of outcome indicators, creating factor scores (which are ambiguous), or creating unit-weighted composites of the indicators with the highest loading, then use those variables as outcomes or predictors. The

relationships between indicators and latent variables as well as the relationships between latent variables are assessed in a single model thanks to SEM, which enables the simultaneous completion of these two elements of the analytical strategy. In Figure 3.7 Hoyle (2012) illustrated this combination of regression analysis and factor analysis in three different ways. On a predictor, X, Y is regressed. Three indicators, y1, y2, and y3, and four indicators, x1, x2, x3, and x4, operationally describe Y and X, respectively. These indicators might be survey questions, total scores on various X and Y measurement tools, behavioral observations, physical traits, or a mix of these and other flimsy construct indicators. Regardless of the method used to obtain the values for these indicators, it is presumed that x1 to x4 represent build X but not Y, and y1 to y3 reflect construct Y but not X.

Regression analysis would need the production of composite scores, maybe by adding x1 to x4 and y1 to y3, or, if the indicators were on different scales, normalizing scores and choosing a mean. Only latent variables (i.e., factors), denoted by ovals, are used in the regression section of the model, as shown in the top panel of Figure 3.7. These are unseen versions of X and Y that capture the similarity among the square-designated observable indicators of them. The uniqueness, or specificity, shown by the little circles, and one of the latent variables of interest, X or Y, are two unobserved factors that contribute to variation in each indicator. Sharply curved lines represent variations, whereas straight lines show directed impacts. The asterisks designate parameters to be estimated. These consist of the variance of X, factor loadings, uniquenesses, a regression coefficient, a disturbance, and a regression error of prediction.

In the remaining portion of Figure 3.7, two additional representations of the same model are displayed. The model is presented in the center panel as a set of equations and "double-label" terms (Bentler and Weeks, 1980). This notational scheme uses the letters v for observed variables, F for latent variables, e for uniquenesses, and d for disturbances. Matrix notation, also known as linear structural relations (LISREL) notation in honor of its usage in the original computer program for implementing SEM (Jöreskog and Sörbom, 1999), is used to represent the model in the bottom panel of Figure 3.7. The variables defined in the model and parameters are denoted by Greek letters, while observed variables are denoted by the symbols x (independent) or y (dependent) in this scheme.

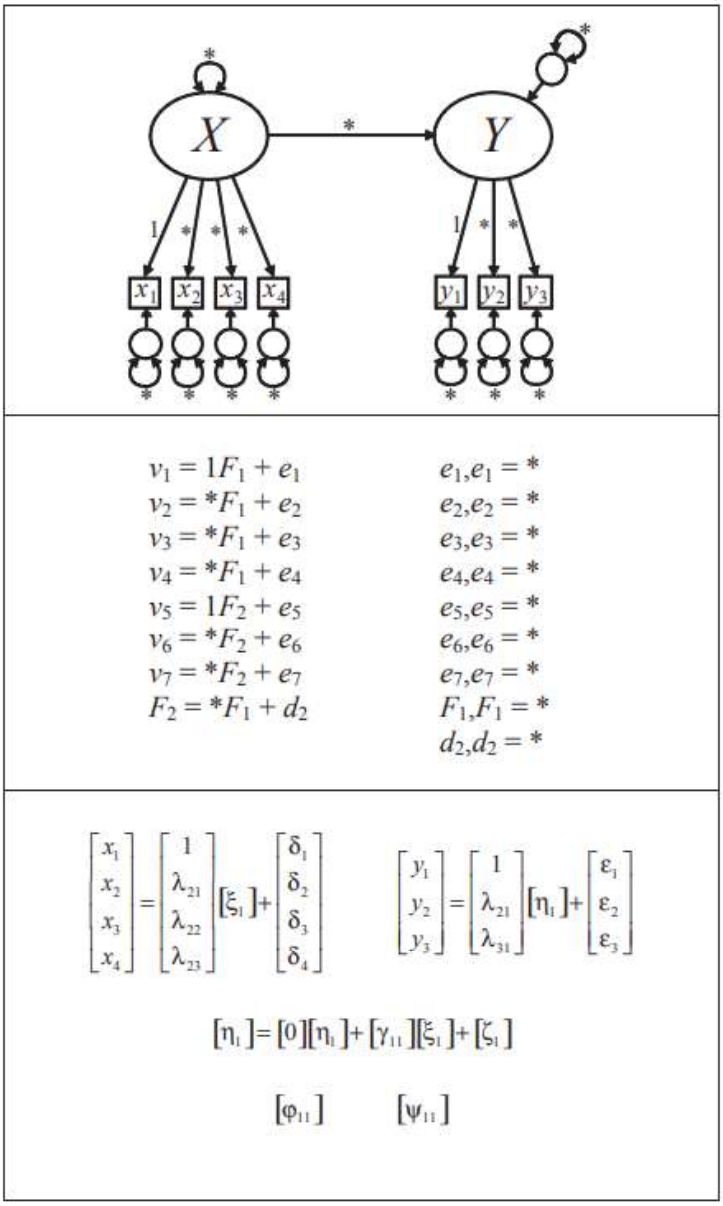

Figure 3.7. Alternative depictions of a model (Hoyle, 2012).

There are several software products with SEM specialization on the market. The most popular ones are EQS (Equations), LISREL (Linear Structural Relationships), and AMOS (Analysis of Moment Structure). AMOS is chosen in this study to examine the research model.

3.5.2.1. Sctural Equation Modeling Steps. Despite its adaptability and applicability, SEM is almost always applied using the same set of discrete stages in reality. Hoyle (2012) give a context for how the stages should be processed by presenting an implementation framework

that places these actions in relation to one another. The framework, which is represented graphically in Figure 3.8, consists of four main steps: specification, estimate, evaluation of fit, interpretation, and reporting. Respecification is a fifth phase that most SEM implementations also contain.

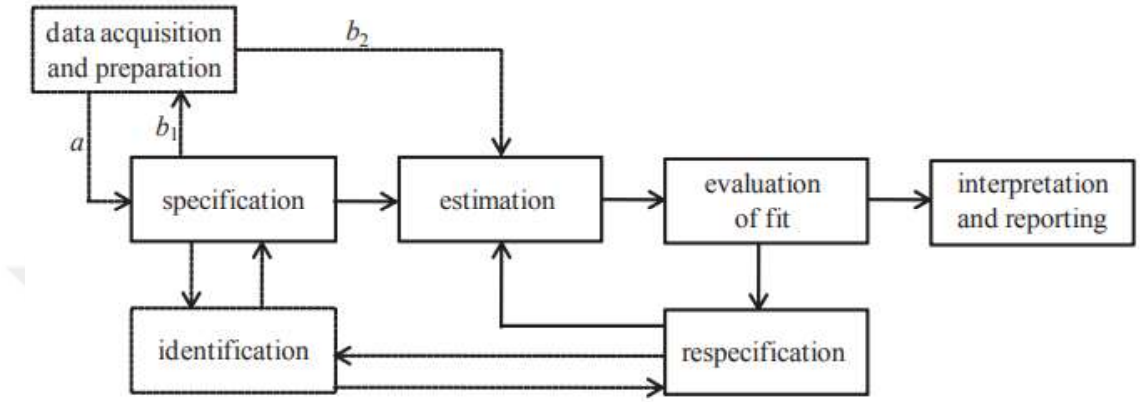

Figure 3.8. SEM implementation steps (Hoyle, 2012).

The specification of a model always comes first in the application of SEM. A formal explanation of the mechanisms presumptively responsible for the emergence of the observed data is a model. These processes take into account features of the sample and the study methodology, as well as the main hypotheses that drove the analysis. The model also has elements that guarantee distinct values may be achieved for the parameters to be estimated. Figure 3.8 illustrates how specification can happen either before or after data are collected and ready for analysis.

Estimation comes after once a model has been defined, its parameters have been determined, and the data have been ready for analysis. Finding free parameter values that minimize the difference between the observed covariance matrix and the estimated, or implied, covariance matrix given the model and the data is the aim of estimation. Depending on which of several potential estimating techniques is employed, the process by which parameter estimations are obtained will vary. Examples include asymptotically distribution-free estimators, weighted least squares (WLS), generalized least squares (GLS), unweighted least squares (ULS), and maximum likelihood (ML). ML is by far the most used estimating technique, and it is typically employed by default in SEM computer applications.

Evaluation of fit need because the parameter estimates that minimize the difference between the observed and inferred covariance matrices are those that are produced from appropriate data for the specified model, but that difference may be quite big or small. In other words, the fixed and estimated parameters may imply either a covariance matrix that is sufficiently similar to the observed covariance matrix to support the conclusion that the model fits the data, or it may imply a covariance matrix in which one or more values are sufficiently different from the observed data to support the conclusion that the model does not fit the data. The evaluation of fit in a SEM study looks at whether the given model provides a reasonable explanation for the data, or if it should be rejected (if the goal is purely confirmatory) or respecified (if the original or reconsidered intent is model generation). Methodologists continue to do study on and to have different point of views about how this assessment is conducted and a conclusion is made.

The so-called Chi- square ($\chi 2$) test is a good place to start when thinking about how fit decisions are made. In truth, the number commonly denoted as $\chi 2$ under circumstances somewhat typical of SEM studies is only a rough estimate. Furthermore, when valid, the statistical test is of a hypothesis that few researchers would accept: that the chosen model adequately explains for the facts that are seen (i.e., there is no discrepancy between the observed and implied covariance matrices). Nevertheless, it is an excellent example of a goodness-of-fit test, the aim of which is to determine if the observed data and the data indicated by a model are same. The lower the chi-square value (closer to zero), the better the model data can be said to fit the observed data. It is difficult to assess model fit using the $\chi 2$ statistic for large sample sizes and complicated models since the statistic is sensitive to sample size and the number of parameters (Iacobucci, 2010). Although it isn't a recognized fit index, the $\chi 2$/df ratio is used to address some of the limitations of $\chi 2$. According to Awang (2012), values lower than 5 are satisfactory, while values lower than 2 show a good match for the $\chi 2$/df ratio (Ullman, 2007).

The RMSEA (Root Mean Square Error of Approximation) is a badness-of-fit metric that decreases as fit increases. The RMSEA has a lower limit of zero. There is no conceivable cap on it. A model with an RMSEA more than 0.10, according to Browne and Cudeck (1993), is not deserving of serious attention. According to studies (Browne and Cudeck,

1993; Jöreskog and Sörbom, 1993), a model-data fit is considered to be reasonable when the RMSEA is less than .08 and close-fit when lesss than .05.

RMSEA is an absolute fit indicator that measures how far from a perfect model a proposed model is. The incremental fit indices CFI (Comparative fit index) and TLI (Tucker and Lewis index), on the other hand, compare the fit of a proposed model to a reference model (i.e., a model with the worst fit). According to Bentler and Bonett (1980), TLI > .90 and CFI > .90 signifies a good match.

TLI was made more broadly applicable to the setting of covariance structure analysis by Bentler and Bonett (1980), who called it the non-normed fit index (NNFI). Nevertheless, the TLI label is still more typical. They developed the TLI using $\chi 2/df$ ratios. They explicitly state that the TLI is conceptually a percentage metric in their definition. Models with NNFI values below 0.9 are typically required to be corrected for better fit.

In light of Figure 3.8, the assessment of fit has the potential to lead the researcher in one of two directions: either interpretation and reporting or respecification. Although interpretation and reporting are the expected outcomes, the evaluation of fit frequently fails to provide evidence in favor of the chosen model and any alternatives, leading the researcher to respecify. Respecification necessitates reconsidering identification, followed by a return to estimate and fit assessment. Regardless of the researcher's initial intentions, once respecification is undertaken, model development becomes the primary objective. Specification searches are used to identify areas of misspecification among the fixed and free parameters of an originally defined model before making decisions about how a model should be changed to enhance its fit. The process of performing specification searches can be either manual, in which case the residual matrix is visually inspected for arbitrary large residuals, or automated, in which case a statistical algorithm is used to calculate the incremental improvement in fit that would result from releasing each fixed parameter or fixing each free parameter.

When a model receives support from the evaluation of fit, the researcher advances to the last stage of the implementation framework. It may come as a surprise that many of the complaints directed at SEM have centered on the interpretation and presentation of results

given the technical difficulties involved with definition, estimate, and fit evaluation (Hoyle, 2012). Because of this, the researcher using SEM must exercise great caution when interpreting findings and disseminating details about the data analysis and findings. The model's basis, the meaning of certain model parameters, and the extent to which the model is unique in accounting for the observed data are the main points of interpretation.

4. ANALYSIS AND RESEARCH FINDINGS

In this part of the thesis study, the analysis of the data gathered through the questionnaire conducted and the hypothesized relations were tested. The questionnaire survey was sent to the construction industry employees in Turkey and the target audience does not include a specific employee group, except that they are aware of the key factors of the company. The goal here is to measure the given importance and investigate approach of construction industry professionals to organizational learning and related factors, and then to test the hypothesized relationships. Before the analysis of the data, first of all, the validity and reliability of the collected answers were measured and whether there was any missing data or unreliable results was tested. Since the prerequisite for completing the online questionnaire survey study was answering all the questions, there was no missing data. However, when all the answers were examined in detail, it was revealed that 4 respondents answered the whole questions with the same answer (3-3-3-3 etc.). For this reason, 4 out of 140 responses received were excluded, so the following analysis was carried out on the responses of 136 participants.

Statistical results and descriptive statistics are presented in the first part of this chapter, initially general information about employees and companies are analyzed and then distribution of rating levels of organizational learning factors investigated. Furthermore, data analysis was carried out by utilizing descriptive statistics and structural equation modeling (SEM) analysis methodologies, respectively. Descriptive statistics tables with details such as mean, standard error, median, standard deviation, sample variance, kurtosis, skewness, range, minimum, and maximum values etc. are presented in Appendix C.

4.1. Descriptive Statistics

In this part, 136 responses collected by questionnaire survey and remaining after the pre-screening were analyzed with descriptive statistics. The analysis here consists of two main parts, in the first part, the questions specifying the characteristics of the relevant companies and employees were investigated. While the questions here include questions about companies such as turnover, number of employees, years of experience, they also

include questions regarding the employees such as the position they work and the year of experience. Then, in the second part with the help of descriptive statistics, the ratings given by the respondents to the organizational learning factors were examined and analyzed.

4.1.1. General Information about Respondents and their Companies

The years of experience of companies and employees, the projects worked on and the identities took on throughout projects contain important information in terms of the profile and characteristics of companies and employees. The figures presented in this section show important statistics about the characteristics of respondent employees and their companies.

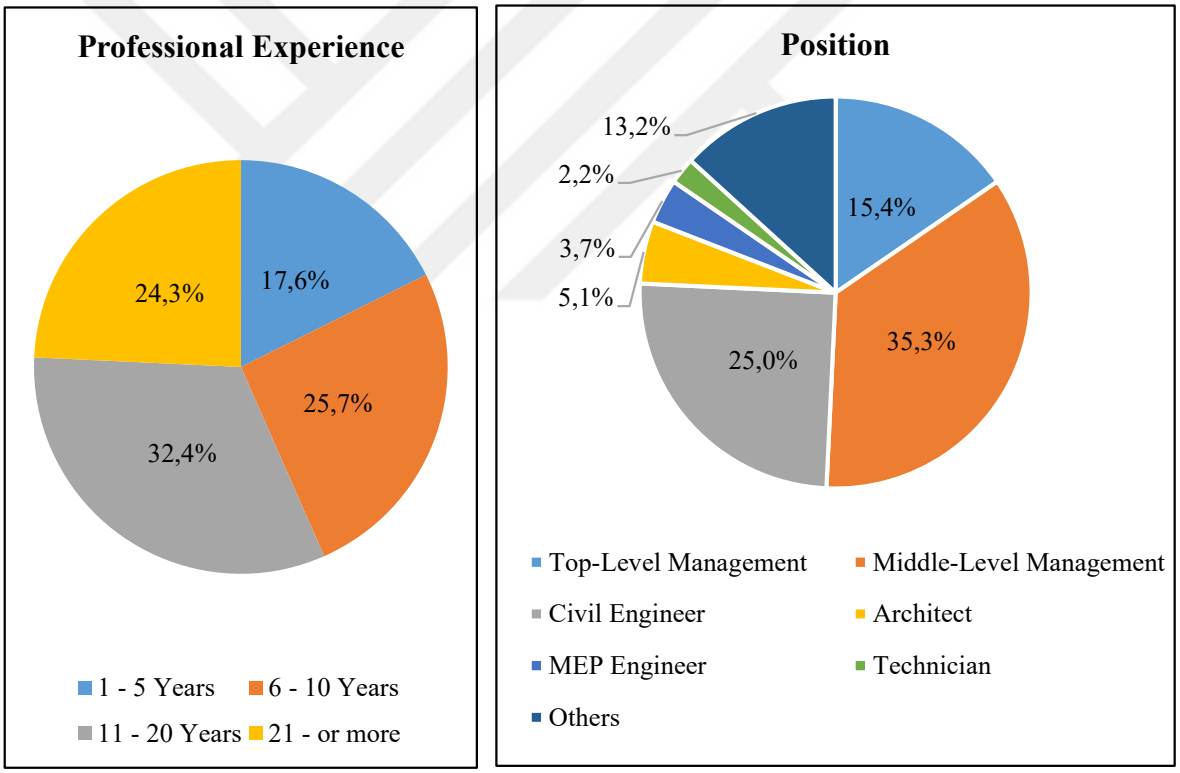

Figure 4.1. Experience and position distribution of the participants.

In Figure 4.1, the yearly experience and also the position distribution of the survey participants can be seen. It can be seen here that the majority of the participants are those with 11 to 20 years of experience (32.4%). Then there are the employees who have 6 - 10 years (25.7%) experience and 21 or more years (24.3%) experience with close ratios. Finally, there are employees with 1 to 5 years of experience with a rate of 17.6%. According to these

statistics, it can be said that the respondents of the study show a close distribution according to their years of experience. According to Figure 4.1, Middle-Level Managers (36.3%) constitute the majority of the participants in the survey, followed by civil engineers (25.0%), then Top-Level Managers (15.4%) come. These statistics show that the vast majority of respondents have a say in company decisions, have knowledge and experience of key factors of the company.

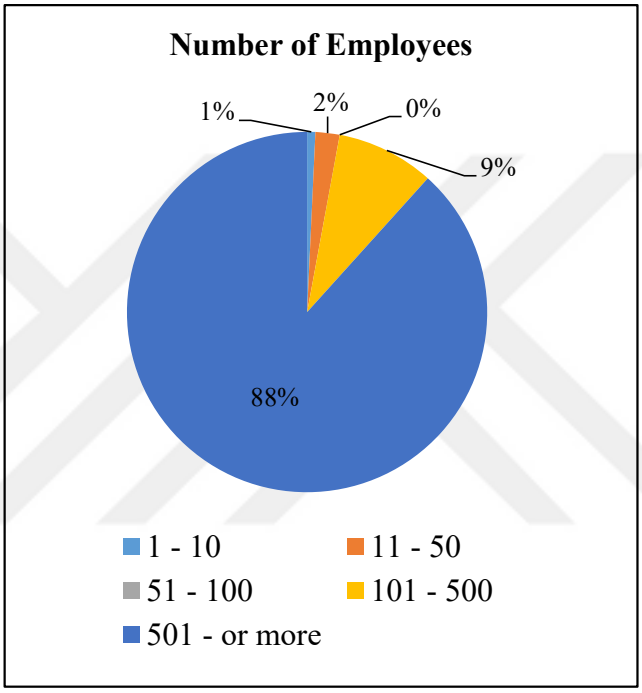

Figure 4.2. Distribution of the number of employees in respondents' companies.

As mentioned before, the questionnaire was sent to the members of the Turkish contractors Association and Institution of Civil Engineering and their member companies. Therefore, the participants are mostly among those working in middle-upper size companies. As can be seen in Figure 4.2, the rate of employing 501 or more employees in the companies where the participants work is 88%. Second biggest portion is the companies that employing between 101 and 500 employees which follow with 9%. It can be seen from these statistics that the companies that the participants work for are middle-upper sized companies.

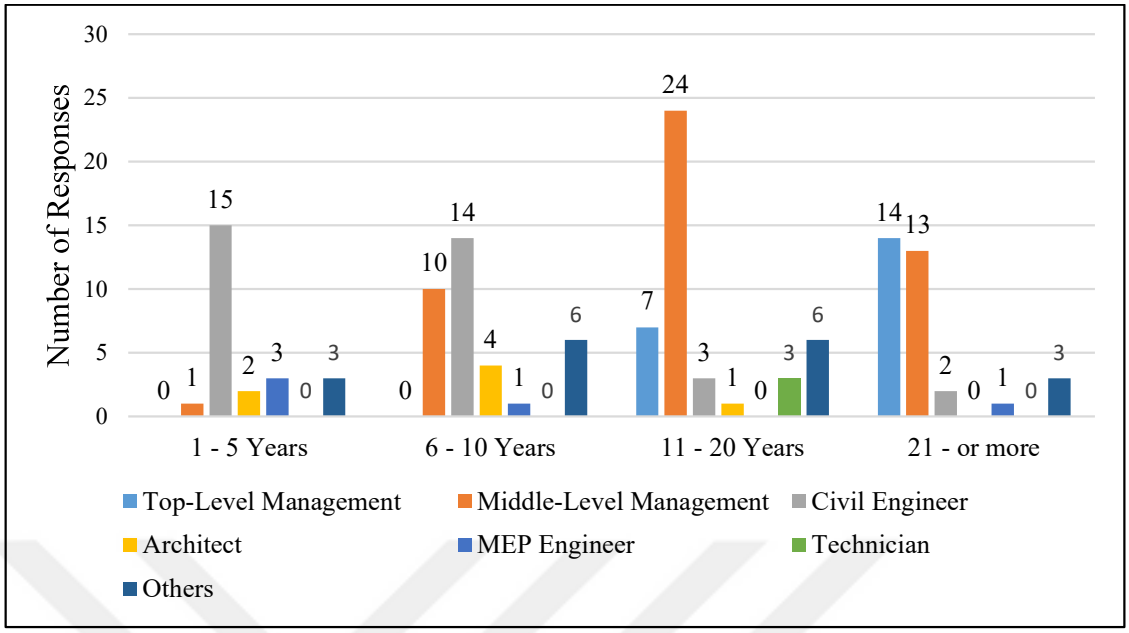

Figure 4.3. Position distribution of respondents according to their experience.

Figure 4.3 shows the distribution of employees by year of employment. It is seen in this graph that 15 of the participating civil engineers, that is 44%, have experience between 1 and 5 years, while 14 of civil engineers, that is 40%, have experience between 6 and 10 years. Looking at the distribution of middle level managers, 24 of the participants, that is 50% of the middle level managers, have experience between 11 and 20 years. As expected, 14 of the top-level management level employees have 21 or more years of experience, which corresponds to 66.6% of the total top-level management level employees.

Figure 4.4 shows the roles of the participants in the construction projects of the companies they work for. Because construction companies did not only play a single role, that is, a company that was the main contractor in one construction project could be a subcontractor in another construction project, respondents had the right to choose more than one option in the question of the role of companies in the survey. 96% of the participating companies defined themselves as the main contractor. This may be due to the fact that the participants work in companies that are members of the Turkish Contractors Association. While 43 of the participants, 32%, define the companies they work with as investors/partners, 23% define their companies as subcontractors, 20% as design and 17% as clients.

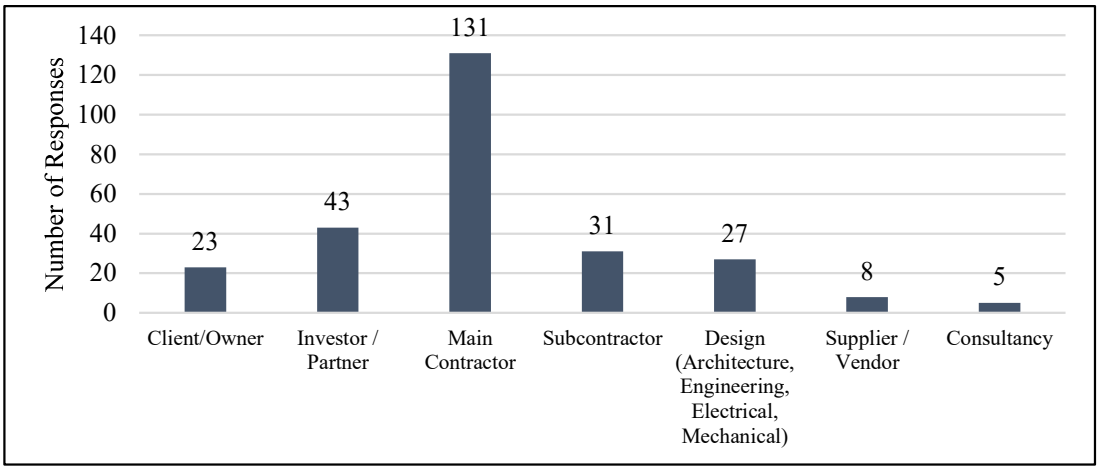

Figure 4.4. Distribution of positions undertaken by companies.

Figure 4.5 shows how many years of experience the participants' companies have in the sector. Considering that the companies they work for are mostly sector leader companies, the statistics that 121 of 136 companies (89%) have 21 years or more experience can be expected.

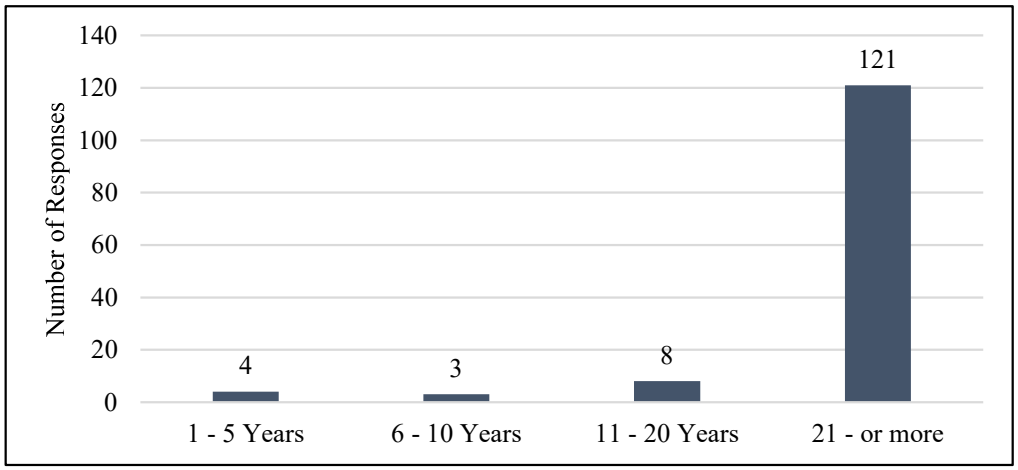

Figure 4.5. Distribution of years of experience in the sector of companies.

Figure 4.5 shows how many years of experience the participants' companies have in the sector. Considering that the companies they work for are mostly sector leader companies, the statistics that 121 of 136 companies (89%) have 21 years or more experience can be expected.

Just as construction companies can assume different roles in each project, in the same way, construction companies take part in different types of projects. For this reason, the participants could select more than one option in the question of the types of projects their companies work on. In Figure 4.6, the distribution of the roles of the companies in which type of projects can be seen. Here, first of all, when the statistics of the type of projects the participants' companies are involved in are examined, it is seen that 72% of the companies take part in infrastructure projects, 62% take part in industrial facility projects, 43% work in commercial structures, 35% take part in residential constructions. Here, the most assumed role in all types of projects is mail contractor, while the next role is investor/partner in all project types. While the design comes in the third place in commercial projects and infrastructure projects, the subcontractor role comes in the third place in residential projects and industrial projects.

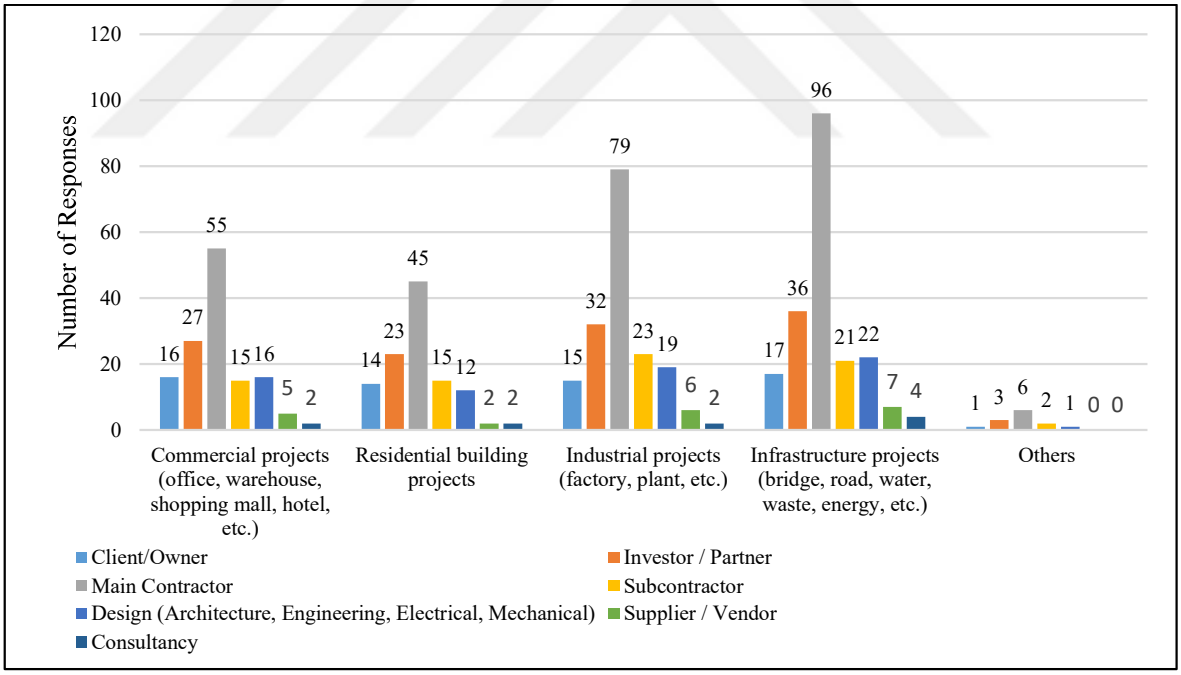

Figure 4.6. Roles of the participants' companies according to the types of projects.

Since another way to understand the size and characteristics of the participants' companies could be to look at the annual turnover of the companies, for that the participants were asked about their company's turnover in a year. As can be expected here, since the companies are among the largest companies in the sector, 96 of them, that is 70% of the

participants, state their annual turnover as 100 million dollars and above, while 6 of them, 5%, indicate between 5 and 100 million dollars. 29 participants stated that they did not have any information on this issue. Figure 4.7, on the other hand, shows the roles undertaken by the companies according to the annual turnover distribution. Here, 68% of companies with a turnover of $100 million or more describe themselves as main contractor, while 22% describe themselves as an investor/partner and 15% as a design company.

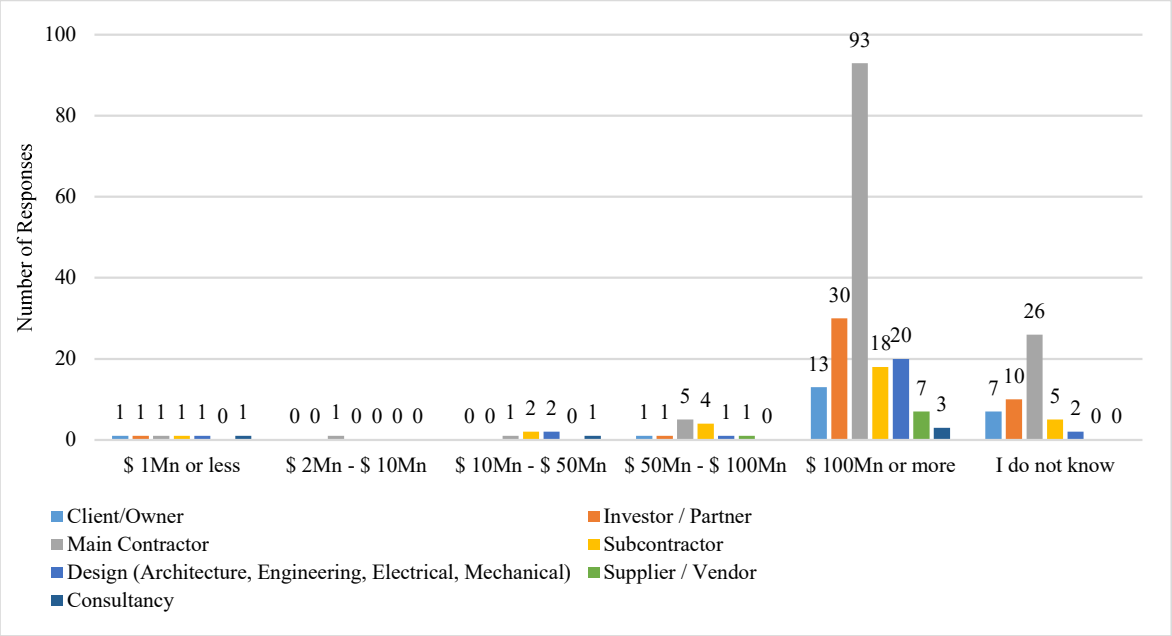

Figure 4.7. Roles of the participants' companies according to the annual turnover distribution.

4.1.2. Distribution of Rating Levels of Organizational Learning

Factors related to organizational learning in construction companies were presented within the framework study presented earlier and also indicated in the hypothesized relationships. In this part of the study, the factors obtained after a detailed literature study, which are thought to affect organizational learning, were analyzed with the mean value formula. As can be seen in the graphs below, it can be concluded that all factors gathered from the literature have proven their validity by the rating of professionals working in construction companies in Turkey, because all factors scored above three on average. Since the conceptual framework for organizational learning with these characteristics corresponds

with the views and opinions of construction professionals, it can be claimed that the study addressed its intended audience. For easier interpretation and understanding of the tables and figures below, the factors in the table are listed according to the number of mentions in the examined literature, the most mentioned factor has the lowest number.

4.1.2.1. Drivers of Organizational Learning. Abbreviations for driver factors are presented in Table 4.1.

Table 4.1. Abbreviations of drivers.

Abbreviation	**Drivers**
D1	Organizational effectiveness
D2	Competitive advantage
D3	Organization's long term survival
D4	Changes in the business environment
D5	Client requirements
D6	Government legislation
D7	Globalisation
D8	Sustainability concerns

In Figure 4.8, the factor averages of organizational learning drivers according to the rates of the construction sector employees in Turkey can be seen. Here, firstly, it can be seen that five of the eight factors prepared according to the literature have an average rating above four. The highest of these is “D1: Organizational effectiveness” with an average of 4.14, followed by “D3: Organization's long term survival” with an average of 4.13. Here, D1 and D3's high scores can be expected according to the number of mentions in the literature, while “D7: Globalisation” has also got a high average, although it is mentioned less frequently in the literature. According to the rates of the industry professionals, the lowest mean point was obtained from the “D6: Government legislation” among the drivers.

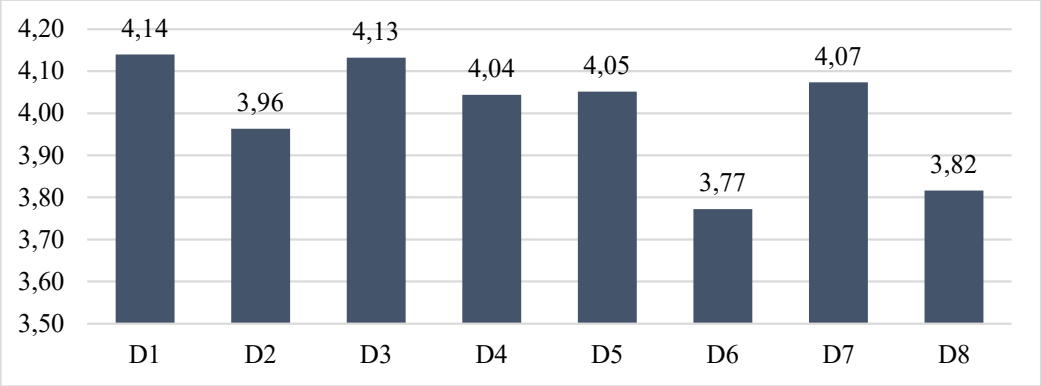

Figure 4.8. Mean ranking of drivers of organizational learning.

4.1.2.2. Inputs of Organizational Learning. Abbreviations for input factors are presented in Table 4.2.

Table 4.2. Abbreviations of inputs.

Abbreviation	**Inputs**
I1	One's own experiences
I2	Knowledge transfer among organizational members
I3	Experience of other organizations
I4	Research and development (R&D)
I5	Organizational routines
I6	Learning from other stakeholders - collaborative working
I7	Partners
I8	Rules and regulations
I9	Acquiring and grafting new members
I10	Trade shows and exhibitions

In Figure 4.9 it can be seen that the average rates of the organizational learning input factors which rated by construction company professionals in Turkey. It can be seen here that all inputs have an average of over three points. As can be seen in the figure, the factor "I1: One's own experiences" gets the highest average rate in parallel with the number of mentions in the examined literature, followed by "I2: Knowledge transfer among organizational members" in the same order. "I3: Experience of other organizations", on the other hand, had the second lowest average in the scope of this study, although it was mentioned more in the literature than the other factors except I1 and I2. From this, it can

concluded that the employees of construction companies in Turkey learn less from the experiences of other organizations compared to other input factors, according to the rates they give. Besides, as expected, trade shows and exhibitions received the lowest ratings. This means that the employees of the construction company in Turkey learn the least from trade shows and seminars when compared to other inputs.

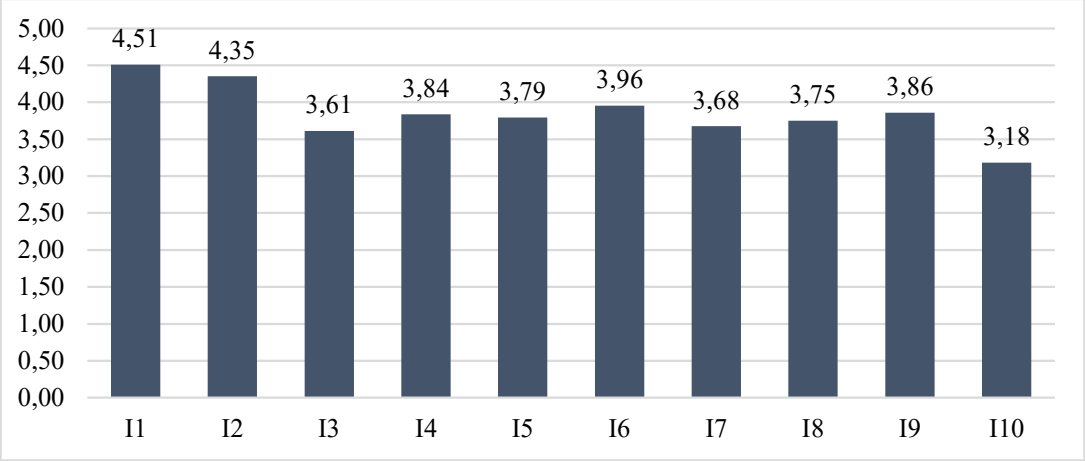

Figure 4.9. Mean ranking of inputs of organizational learning.

4.1.2.3. Enablers of Organizational Learning. Abbreviations for enabler factors are presented in Table 4.3.

Figure 4.10 shows the average of the enabler factors of organizational learning as a result of the rates of the professionals of the construction companies. The highest facilitator appears as “E4: Top management - leaders support” with average point of 4.51. This shows that the management approach which supports organizational learning in the construction sector in Turkey is the most effective factor compared to other facilitators. Second most importantly, parallel to the number of mentions in the examined literature, “E2: Knowledge sharing mechanisms” appear as an enabler with a 4.31 average point. “E5: Goal clarity - shared vision comes next with a very close score. It is seen that all facilitators except for two of the facilitators are above four points on average. The last two factors, are the two least mentioned in the literature, also obtained the lowest average points in this study results.

Table 4.3. Abbreviations of enablers.

Abbreviation	Enablers
E1	Embracing the change and innovation culture
E2	Knowledge sharing mechanisms
E3	Coordination and integration among stakeholders
E4	Top management - leader support
E5	Goal clarity - shared vision
E6	Encouraging personal skills and involvement
E7	Education for individual and organization
E8	Feedback mechanisms
E9	Partners - collaborative working
E10	Heterogeneous experience

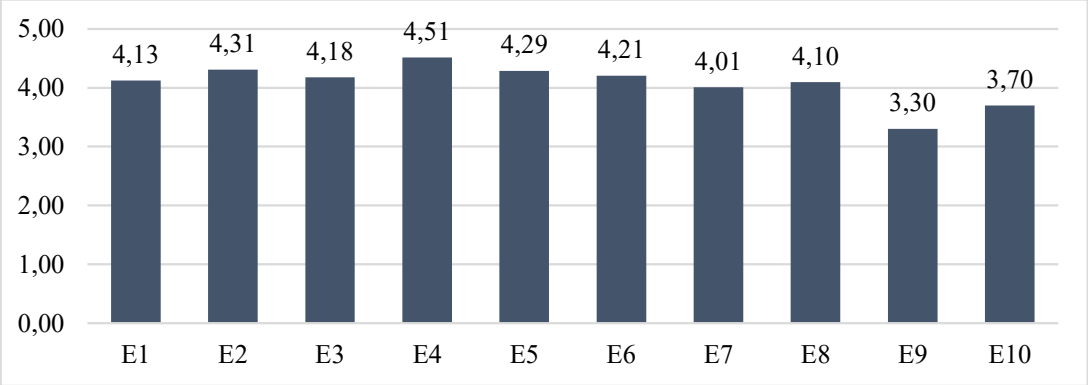

Figure 4.10. Mean ranking of enablers of organizational learning.

4.1.2.4. Barriers to Organizational Learning. Abbreviations for barrier factors are presented in Table 4.4 and Figure 4.11 shows the average points of the barrier factors against of organizational learning as a result of the rates of the employees of the construction companies. After a detailed literature review, 12 factors were prepared as a barrier to organizational learning in the construction industry. After this factor rating questionnaire survey conducted with the construction industry employees in Turkey, it is revealed that the barrier with the highest average against organizational learning is "B7: Lack of top management support". This is in parallel with the previous enabler, "E4: Top management - leader support", which is the most important facilitator among of enabler factors.

Table 4.4. Abbreviations of barriers.

Abbreviation	Barriers
B1	Lack of participation and communication
B2	Lack of organizational structure and culture
B3	Lack of innovation culture
B4	Complex and changing environment
B5	Fragmented nature of the industry
B6	Rigid and outdated core beliefs, applications
B7	Lack of top management support
B8	Ambiguous goals
B9	Lack of resources
B10	Lack of structured framework for learning
B11	Lack of knowledge to implement innovation
B12	Lack of well-trained human resources in the sector

“E4: Top management - leader support” factor also proves that the importance of management and leadership support for the organizational learning in construction industry companies in Turkey is significantly critical. Contrary to the number of mentions in the reviewed literature, “B9: Lack of resources” comes as the second most important barrier. From this, it can be inferred that the employees of the construction companies in Turkey think that inadequate resources for organizational learning constitute a more important obstacle than the 10 barriers.

The third most important obstacle is “B1: Lack of participation and communication”, which is the most mentioned in the examined literature, and this is immediately followed by “B8: Ambiguous goals”, like “E5: Goal clarity - shared vision”, which comes as third in enablers. “B4: Complex and changing environment” was calculated as the barrier with the lowest mean, not paralleling the rate of mention in the reviewed literature. This leads to the conclusion that the employees of construction companies in Turkey perceive the complex and rapidly changing environment as a less important barrier compared to other barriers.

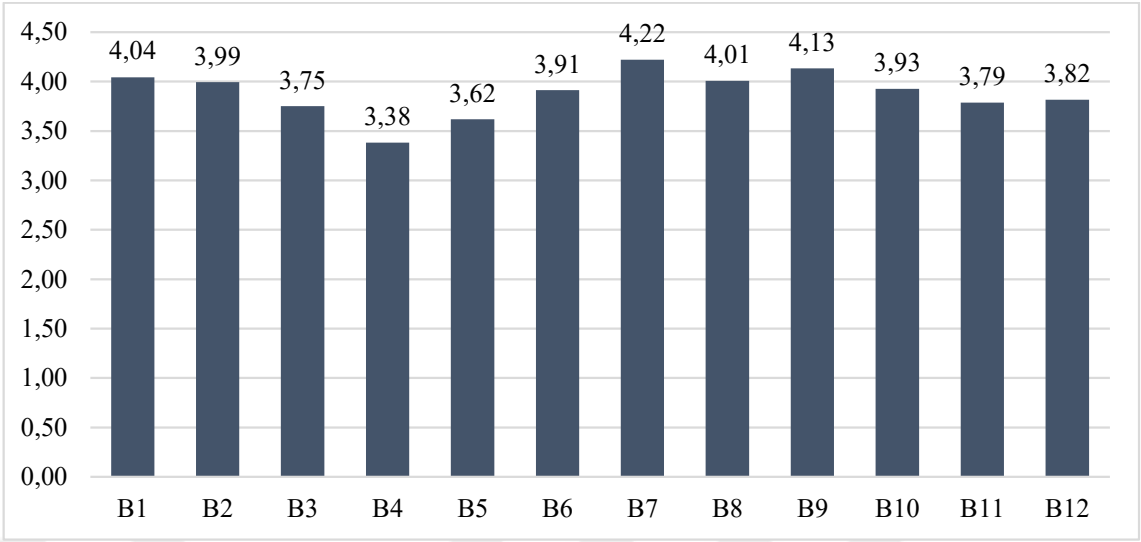

Figure 4.11. Mean ranking of barriers to organizational learning.

The third most important obstacle is “B1: Lack of participation and communication”, which is the most mentioned in the examined literature, and this is immediately followed by “B8: Ambiguous goals”, like “E5: Goal clarity - shared vision”, which comes as third in enablers. “B4: Complex and changing environment” was calculated as the barrier with the lowest mean, not paralleling the rate of mention in the reviewed literature. This leads to the conclusion that the employees of construction companies in Turkey perceive the complex and rapidly changing environment as a less important barrier compared to other barriers.

4.1.2.5. Impacts of Organizational Learning. Abbreviations for impact factors are presented in Table 4.5 and Figure 4.12 shows the average of the corporate-level impact factors of organizational learning as rated by Turkish construction industry employees. First, it can be seen that each of the seven impacts rated has an average score above the 3.8. This means that all selected seven effects which were obtained from a detailed literature study had chosen in accordance with the aim of the study and the perception of the target audience. Parallel to the number of mentions in the scanned literature, “IM1: Competitive advantage” rated as the most important impact with an average point of 4.31.

Table 4.5. Abbreviations of impacts.

Abbreviation	Impacts
IM1	Competitive advantage
IM2	Integration of business processes and participants
IM3	Enhance decision-making abilities
IM4	Organizational effectiveness
IM5	Achieving budget goal
IM6	Adaptation to changing environment
IM7	Innovation capability improvement

Surprisingly, although less mentioned in the literature, “IM5: Achieving budget goal” has the second highest mean with the average point of 4.26. Based on these first two effects, it can be seen that the construction sector employees in Turkey attach more importance to the effects of organizational learning on adapting to the environment and achieving their budget goals. Thirdly, “IM3: Enhance decision-making abilities” with an average close to IM5 has come with 4.23 average. “IM4: Organizational effectiveness” appears to be the least impactful factor of organizational learning on the corporate level.

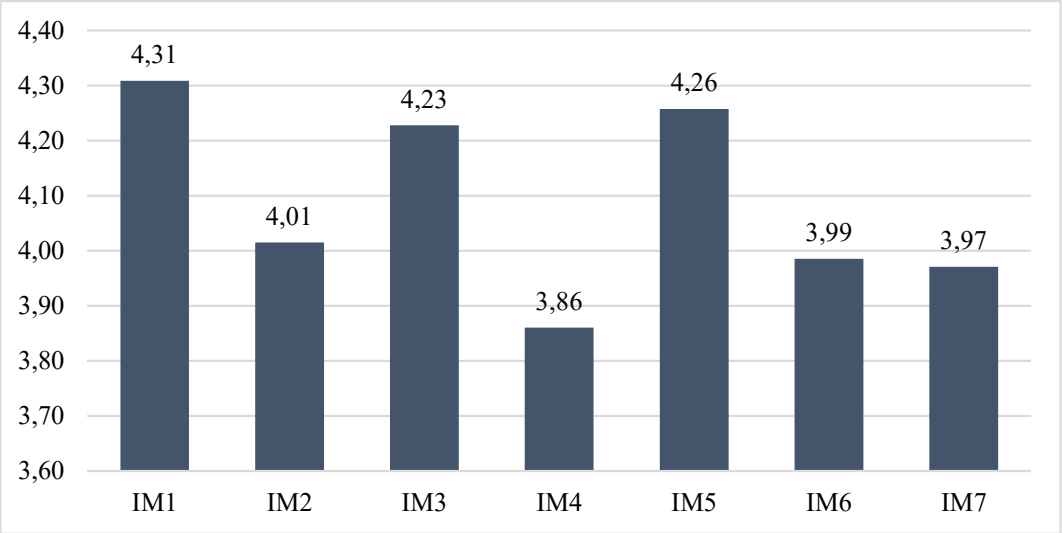

Figure 4.12. Mean ranking of impacts of organizational learning.

4.1.2.6. Benefits of Organizational Learning. Abbreviations for benefit factors are presented in Table 4.6.

Table 4.6. Abbreviations of benefits.

Abbreviation	Benefits
BE1	Accurate cost estimates
BE2	Reduced costs
BE3	Accurate timetables
BE4	Reduced time
BE5	High quality of final product
BE6	Enhanced construction productivity

Figure 4.13 shows the average values calculated as a result of the questionnaire survey where project-level benefit factors of organizational learning rated by the construction company employees in Turkey. First of all, it can be seen that all project-level benefits rated are above the average score of 4.0. This shows that the benefit factors obtained by the detailed literature study are suitable for the purpose of the study, the perception of the selected target audience and the dynamics of the sector.

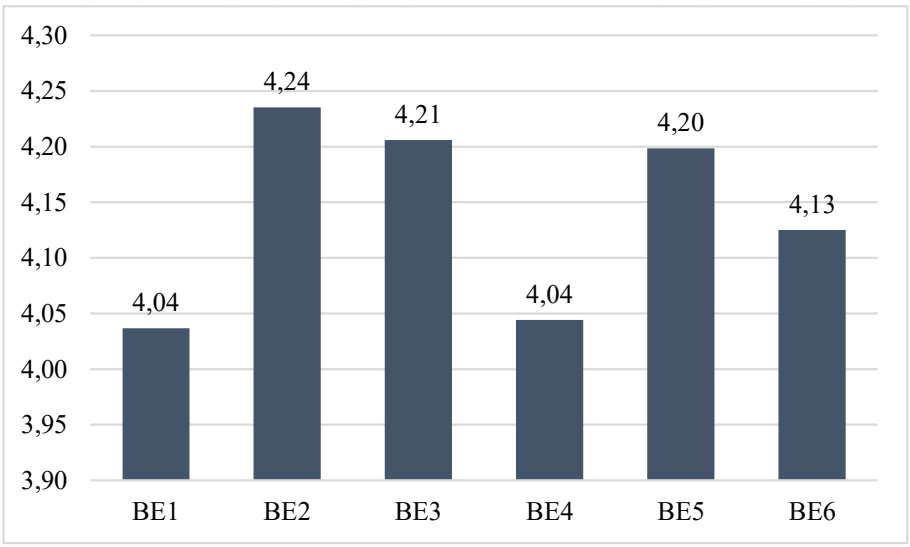

Figure 4.13. Mean ranking of benefits of organizational learning.

While all project-level benefit factors showed close results, “BE2: Reduced costs” showed the highest result with an average score of 4.24. “BE3: Accurate timetables” came in second with an average point of 4.21 and “BE5: High quality of final product” came in the 3rd order of importance with an average score of 4.20. As for the benefit with the lowest

average score at the project level, the employees of the construction company in Turkey rated "BE4: Reduced time", but this does not mean that they indicated organizational learning does not reduce the time of the projects. This means that according to their average opinion organizational learning leads to a reduction in calculated costs more than accuracy, but leads to more accuracy in the timetables rather than a reduction in time.

4.2. Structural Equation Modeling (SEM)

Structural equation modeling (SEM) is a group of statistical methods which are used to quantify and examine the connections between latent and observable variables. It explores linear causal links among variables while concurrently taking measurement error into account, making it similar to but more effective than regression analysis. Since the 1980s, SEM has been widely employed in several research projects (Xiong et al., 2015), although its usage in construction research is less prevalent than in the social sciences and is still relatively new (Cardak, 2019). Within the scope of this study, SEM was implemented in five main steps: specification, estimation, evaluation of fit, respecification (modification), interpretation, and reporting. In addition, to examine and analyze the collected data, SEM mainly consists of two components: measurement model and structural model.

4.2.1. Investigating the Measurement Model

SEM consist of the measuring model and the structural model. Latent variables or composite variables are measured by measurement models, whereas path analysis-based structural models examine all potential relationships (Hoyle, 2011). Within the scope of the measurement model, we first assign the latent variables of the framework we have determined and the measured variables that are related to these variables. In the framework prepared within the scope of this study, there are six main latent variables: "inputs", "drivers", "enablers", "barriers", "impacts" and "benefits". There are 53 measured variables associated with these variables. 136 responses of the questionnaire prepared to measure the approach of construction companies in Turkey to the concept of organizational learning were assigned to these measured variables with the help of AMOS V26.0 software and the analysis was carried out. There is some evidence that even with a small sample size, straightforward SEM models may be usefully assessed (Hoyle and Kenny, 1999; Marsh and Hau, 1999).

However, N = 100 - 150 is typically regarded as the minimal sample size for SEM (Tinsley and Tinsley, 1987; Anderson and Gerbing, 1988; Ding, Velicer, and Harlow, 1995; Tabachnick and Fidell, 2001).

4.2.1.1. Validity and reliability of the organizational learning components and indicators. It is crucial for researchers to consider the validity of their tools. According to Karakaya-Ozyer and Aksu-Dunya (2018), the correctness of a test result is what is meant by validity. The degree to which real data from the dataset was gathered or processed is a measure of a research tool's or dataset's validity. Validity must be ensured as a result. In the case of SEM analysis, it gives researchers proof that the findings may be properly understood. The evaluation may be divided into three categories when analyzing the validity: content validity testing, convergent validity, discriminant validity.

As described under the definition of reliability, consistency in measuring results. Since it relates to how consistently the instrument's parts are measured, reliability testing is important. A scale is considered to have strong internal consistency reliability if the items work together and measure the same construct. In order to measure the reliability scale reliability testing applications may used.

Content Validity Testing: The degree to which a test or assessment instrument assesses every facet of the concept, pattern, or behavior that it is intended to assess is known as content validity. A test with high content validity completely covers the subject for the intended audience. Lower scores imply that the test does not cover all necessary aspects of the subject. Examining each test question to determine if it focuses on the traits that the instrument is intended to address is how content validity is determined. In this procedure, the test is compared to its objectives and the construct's theoretical characteristics. Since there isn't a formal statistical test that can be used to determine content validity, the researcher must use their best judgment and insight (Cardak, 2019; Garver and Mentzer, 1999). Within the scope of this study, a comprehensive literature review was conducted in order to develop a framework study that will fully cover the organizational learning process and concept. The latent variables (main titles) and measured variables obtained as a result of the analysis of 48 academic studies, which were reached after detailed examination and elimination, can be seen in Table 4.7.

Table 4.7. Table of latent variables and measured variables with levels.

Drivers of Organizational Learning		**Levels**
1	Organizational effectiveness	Organizational
2	Competitive advantage	Organizational
3	Organization's long term survival	Organizational
4	Changes in the business environment	Organizational
5	Client requirements	Project/Market
6	Government legislation	Project/Market
7	Globalisation	Organizational
8	Sustainability concerns	Organizational
Inputs of Organizational Learning		
1	One’s own experiences	Organizational
2	Knowledge transfer among organizational members	Individual
3	Experience of other organizations	Project/Market
4	Research and development (R&D)	Project/Market
5	Organizational routines	Organizational
6	Learning from other stakeholders - collabrative working	Project/Market
7	Partners	Organizational
8	Rules and regulations	Project/Market
9	Acquiring and grafting new members	Individual
10	Trade shows and exhibitions	Individual
Enablers of Organizational Learning		
1	Embracing the change and innovation culture	Organizational
2	Knowledge sharing mechanisms	Organizational
3	Coordination and integration among stakeholders	Project/Market
4	Top management - leader support	Organizational
5	Goal clarity - shared vision	Organizational
6	Encouraging personal skills and involvement	Individual
7	Education for individual and organization	Individual
8	Feedback mechanisms	Project/Market
9	Partners - collaborative working	Organizational
10	Heterogeneous experience	Organizational

Table 4.7. Table of latent variables and measured variables. (cont.)

Barriers to Organizational Learning		
1	Lack of participation and communication	Individual
2	Lack of organizational structure and culture	Organizational
3	Lack of innovation culture	Organizational
4	Complex and changing environment	Project/Market
5	Fragmented nature of the industry	Project/Market
6	Rigid and outdated core beliefs, applications	Organizational
7	Lack of top management support	Organizational
8	Ambigous goals	Organizational
9	Lack of resources	Organizational
10	Lack of structured framework for learning	Organizational
11	Lack of knowledge to implement innovation	Organizational
12	Lack of well-trained human resources in the sector	Individual
Impacts of Organizational Learning		
1	Competitive advantage	Organizational
2	Integration of business processes and participants	Organizational
3	Enhance decision-making abilities	Organizational
4	Organizational effectiveness	Organizational
5	Innovation capability improvement	Organizational
6	Achieving budget goal	Organizational
7	Adaptation to changing environment	Organizational
Benefits of Organizational Learning		
1	Accurate cost estimates	Project/Market
2	Reduced costs	Project/Market
3	Accurate timetables	Project/Market
4	Reduced time	Project/Market
5	High quality of final product	Project/Market
6	Enhanced construction productivity	Project/Market

Convergent validity testing: When two measurements that are meant to measure the same construct are combined, convergent validity demonstrates their relationship. Convergent validity is the correlation of results from several variables used to evaluate the same construct. The presence of variables that are linked to the latent construct being assessed is ensured by convergent validity. Factors ought to be strongly correlated with the latent construct as a consequence. In order to measure convergent validity there are two main methods: goodness-of-fit and factor loadings. To assess the goodness-of-fit ratio of $\chi 2$ to degrees of freedom (dof), CFI, TLI, and the RMSEA values are checked. In addition, according to results from AMOS software all of the factor loadings of initial model are founded significant at t $\alpha = 0.05$.

Discriminant validity testing: When a test is discriminantly valid, it may be determined whether it does not correlate with tests that assess other constructs. This is predicated on the notion that it wouldn't be reasonable to anticipate getting identical answers from two tests that are designed to examine various things. By contrasting the outcomes of a test that measures one thing with those of an evaluation that measures a completely other thing, discriminant validity may be examined. The test can be regarded to have high discriminant validity if there is no association between the scores; conversely, a significant correlation would suggest low discriminant validity. To ensure discriminant validity, Kline (2011) suggested that correlations between constructs not exceed 0.90 and Hair et al. (1998) indicated that values under 0.90 represents there is no multicollinearity. All inter-correlations are found to be less than 0.90 in the correlation matrices that were generated for all latent variables and reported at the Appendix D of this study.

Scale reliability testing: The consistency or dependability of a construct's measure is referred to as reliability. In other words, assuming the underlying phenomena does not change, would the same result be obtained if this scale were used to assess the same construct more than once. Scale size is taken into account in the reliability assessment process via Cronbach's alpha, a reliability metric created by Lee Cronbach in 1951. Internal consistency, or how closely connected a group of things are to one another, is measured by Cronbach's alpha. It is regarded as a gauge of scale dependability. Even if alpha has a high value, the measure may not be one-dimensional. Nunnally (1978) provided a general guideline of 0.7 value, indicating that anything below that line is inappropriate. Table 4.8 shows the

Cronbach's alpha values for which each construct of organizational learning was calculated, and as it can be seen, all of them have satisfactory values above 0.70. Recently, several academics have a tendency to mention an alpha of 0.8 as the least. The amount of components that make up the scale has a significant impact on alpha.

Table 4.8. Latent variables' Cronbach's alpha values.

Latent Variables	Cronbach's Alpha Values
Drivers	0.757
Inputs	0.811
Enablers	0.884
Barriers	0.932
Corporate Level Impacts	0.883
Project Level Benefits	0.865

4.2.2. Investigating the Structural Model

In this section, 136 responses obtained with the questionnaire prepared according to a deep literature review were analyzed with the structural equation modeling. As explained in detail in the methodology section, five main steps were followed for SEM: model specification, model estimation, evaluation of fit, respecification, interpretation and reporting. The main purpose here is to investigate the direct and indirect relationships between observed and latent variables.

4.2.2.1. Model Specification: According to 48 academic studies obtained after a detailed literature study, 53 factors that have an impact on organizational learning in the construction sector were found. Meanwhile, the frameworks shaped around the concept of organizational learning in the literature were also examined and the model that was thought to explain the concept most comprehensively was selected and presented. In addition to the literature review, academic support was also received and interviews were made with professionals who have been working in the sector for many years. After all these studies, the predicted relationship between the components explained in the Chapter 3.3 and can be seen in Figure 4.14.

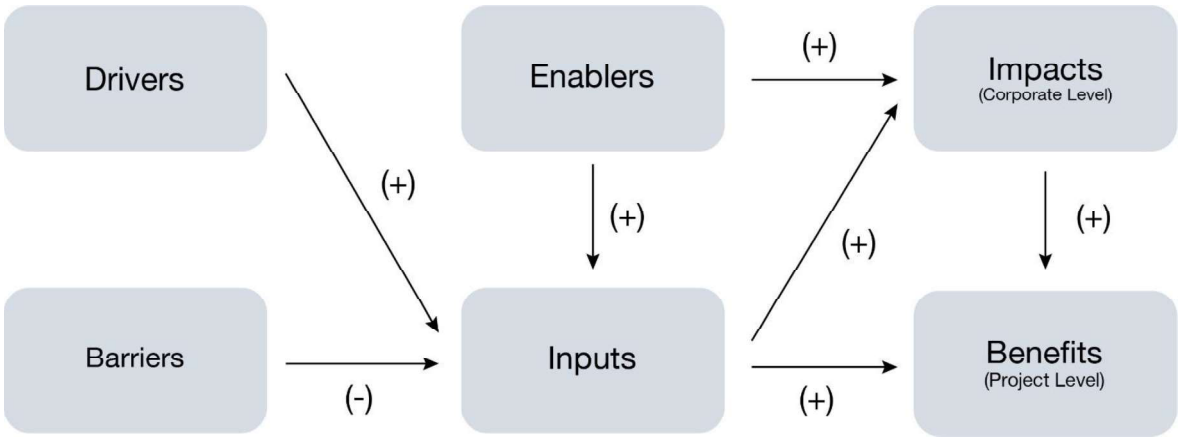

Figure 4.14. Initial model of organizational learning.

4.2.2.2. Model Estimation: There are many methods for structural equation modeling estimation within AMOS software, the most common of which is Maximum Likelihood (ML). A technique called maximum likelihood estimation is used to estimate the parameters of a model. The parameter values are chosen in a way that maximizes the possibility that the model's process truly created the observed data. The important thing to be considered when estimation is done with this method is whether the data taken into account is normally distributed or not. As explained in detail in Section 3.6.1, kurtosis and skewness values were used to measure the convergence of the data to normal. As mentioned earlier, according to Hair et al. (2006) and Bryne (2010), data is considered as normal if the skewness and kurtosis are within a range of 2 to +2 and 7 to +7, respectively. As can be seen in Appendix C, it can be easily said that data shows normal distribution characteristics by looking at the skewness and kurtosis values. As a result, ML is selected to analyze the data using AMOS software.

4.2.2.3. Evaluation of the fit: One of the fundamental problems in structural equation modeling is measuring how well the model fits the data (SEM). After examining the goodness of fit for the structural equation model, it was decided that the data is at or close to the valid and reliable limits. Then, the analysis of the initial model was performed in AMOS software to calculate the path coefficients that measure the relationship between the latent variables. The first model's path coefficients between the latent variables can be seen in Figure 4.15.

4.2.2.4. Model respecification (modification): As a result of the analysis carried out according to the first model, it was revealed that the path coefficients from the barrier to the inputs was not significant at 5%. For this reason, this path has been removed. As a result, Figure 4.15 can be seen as the initial model and Figure 4.16 can be seen as the final model with path coefficients. All path coefficients in the final model are significant at 5%.

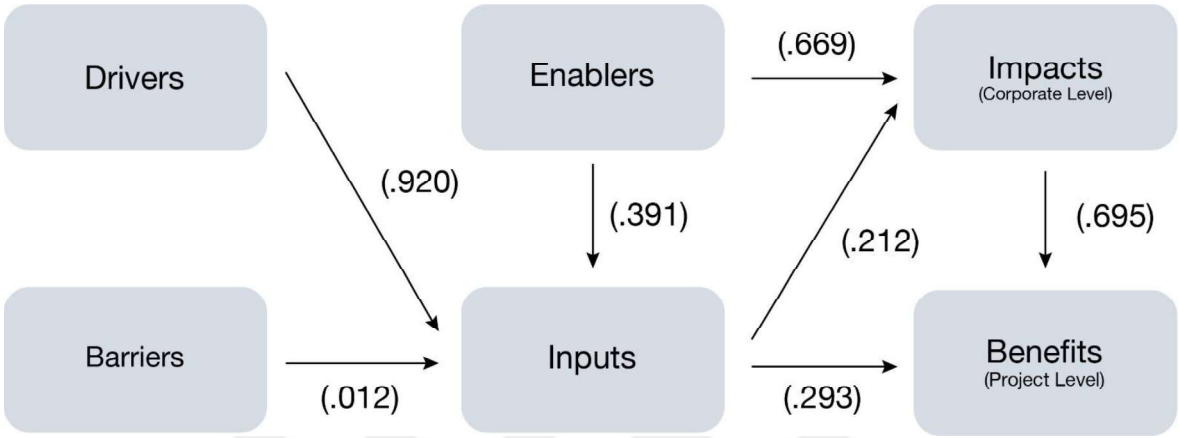

Figure 4.15. Initial model and path coefficients between latent variables.

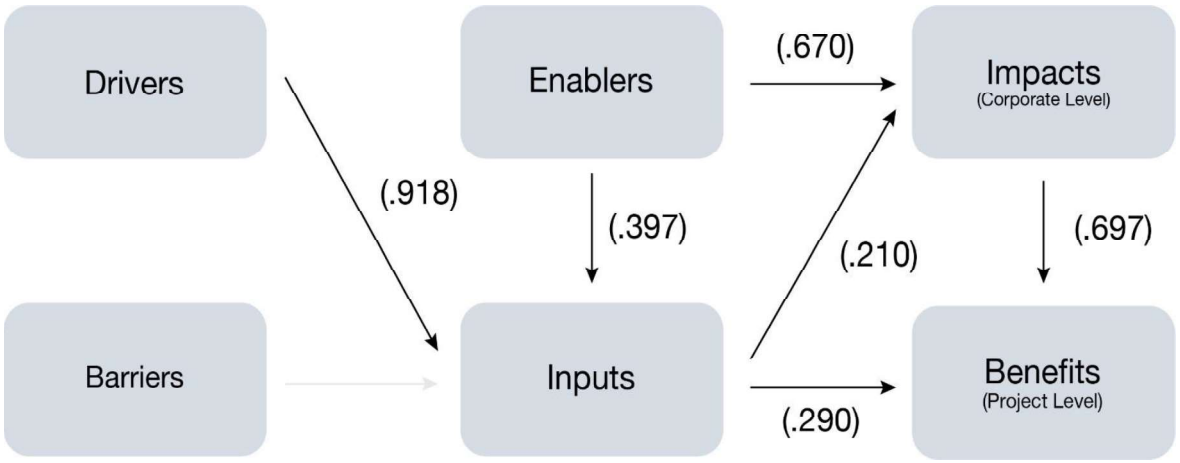

Figure 4.16. Final model and path coefficients between latent variables.

According to the final model, it is seen that the drivers have a strong positive effect on the input (0.918). It has also been revealed that enablers have a positive effect not only on inputs (0.397), but also on impacts (0.670). As expected in the first model, enablers have a high positive effect on impacts (0.670), and impacts have a significant positive effect on

benefits (0.697). Finally, it has been seen that the inputs have a relatively smaller positive effect on impacts (0.210) and on benefits (0.290). Completely different from what expected in the first model, it was found that the barriers did not have any significant effect at 5% on inputs. In addition, according to the results of the analysis, all the factor loadings were significant at 5% for both the first model and the last model and factor loading values has listed in Table 4.10.

In Table 4.9, reliability values and fit indices are presented together with the recommended values. In addition, Cronbach's alpha values of latent variables are shown in Table 4.8. It can be seen from here that all Cronbach's alpha values fit Nunnally's (1978) value of 0.70 and above. The $\chi 2$ to dof ratio is 1.441 for the first model and 1.439 for the final model, which is below the upper value of 3 suggested by Kline (1998). If the RMSEA value is below 0.10, it is considered as a good fit by Kline (1998), and it can be seen in the Table 4.9 that the values for the first model and second model are below 0.10. According to Hu and Bentler, (1998), RMSEA values between 0.05 and 0.08 are considered acceptable fit.

Table 4.9. Reliability values and fit indices for the initial and final model.

Index	Recommended Value	Initial Model	Final Model
$\chi 2$/dof	< 3	1.441	1.439
CFI	0 (no fit) to 1 (perfect fit)	.858	.858
TLI	0 (no fit) to 1 (perfect fit)	.847	.847
RMSEA	< 0.10	.057	.057

There is only a slight discrepancy between the values of the CFI and TLI between the recommended values and the values we encounter in the model. According to Awang (2012) and Hoyle (2012), 0.90 for CFI and TLI values is seen as the lower limit. It has been noticed that the reason for this may be that the number of measured variables connected to latent variables may have been too high for a model with a sample size of this number. All inter-correlations are found to be lower than 0.90 in the correlation matrices that are given in Appendix D of this study which indicate the absence of multicollinearity (Hair et al., 1998). It may be said that there is a reasonable overall fit between the model and the data.

Table 4.10. Factor loadings of latent variables in initial and final model

No	Variable Name	Initial Model	Final Model
Drivers of Organizational Learning			
1	Organizational effectiveness	.569	.569
2	Competitive advantage	.382	.382
3	Organization's long term survival	.537	.538
4	Changes in the business environment	.588	.588
5	Client requirements	.475	.475
6	Government legislation	.602	.602
7	Globalisation	.575	.575
8	Sustainability concerns	.480	.480
Inputs of Organizational Learning			
1	One's own experiences	.322	.321
2	Knowledge transfer among members	.603	.602
3	Experience of other organizations	.504	.503
4	Research and development (R&D)	.483	.484
5	Organizational routines	.450	.451
6	Learning from other stakeholders	.468	.468
7	Partners	.476	.477
8	Rules and regulations	.617	.617
9	Acquiring and grafting new members	.462	.462
10	Trade shows and exhibitions	.511	.512
Enablers of Organizational Learning			
1	Embracing the change and innovation culture	.594	.595
2	Knowledge sharing mechanisms	.618	.618
3	Coordination and integration among stakeholders	.646	.646
4	Top management - leader support	.734	.734
5	Goal clarity - shared vision	.755	.755
6	Encouraging personal skills and involvement	.760	.760
7	Education for individual and organization	.777	.777
8	Feedback mechanisms	.744	.743
9	Partners - collaborative working	.350	.350
10	Heterogeneous experience	.263	.263
Barriers to Organizational Learning			
1	Lack of participation and communication	.664	.664
2	Lack of organizational structure and culture	.670	.670
3	Lack of innovation culture	.691	.691
4	Complex and changing environment	.541	.541
5	Fragmented nature of the industry	.586	.585
6	Rigid and outdated core beliefs, applications	.800	.800

Table 4.10. Factor loadings of latent variables in initial and final model (cont.).

No	Variable Name	Initial Model	Final Model
7	Lack of top management support	.869	.869
8	Ambiguous goals	.873	.873
9	Lack of resources	.783	.783
10	Lack of structured framework for learning	.817	.816
11	Lack of knowledge to implement innovation	.774	.775
12	Lack of well-trained human resources in the sector	.646	.646
Impacts of Organizational Learning			
1	Competitive advantage	.558	.558
2	Integration of business processes and participants	.766	.767
3	Enhance decision-making abilities	.736	.737
4	Organizational effectiveness	.800	.800
5	Innovation capability improvement	.745	.746
6	Achieving budget goal	.661	.661
7	Adaptation to changing environment	.640	.640
Benefits of Organizational Learning			
1	Accurate cost estimates	.632	.632
2	Reduced costs	.672	.672
3	Accurate timetables	.701	.702
4	Reduced time	.733	.733
5	High quality of final product	.662	.662
6	Enhanced construction productivity	.751	.751

5. DISCUSSION OF RESEARCH FINDINGS

In this section, the findings obtained after the analysis of the framework study introduced in the previous sections were examined and these findings were compared with the studies in the literature. The data obtained as a result of the study were analyzed in two main categories and the findings were obtained from these analyses. Using descriptive statistics as the first step of the analysis, general information about companies and respondents was analyzed first. Then, the average values of the factors that determine the main factors of the organizational learning framework were compared. Finally, the prepared framework was analyzed with the structural equation modeling (SEM) method.

The prepared framework consists of six main factors: “inputs”, “drivers”, “enablers”, “barriers”, “benefits”, “impacts”. As sub-factors of these factors, a total of 53 factors were determined after an in-depth literature review. These 53 factors were sent to the professionals working in the construction companies in Turkey, then erroneous answers were eliminated and as a result, 136 answers were acquired for the analysis. After 53 factors were analyzed with the mean ranking method, the framework was analyzed with the SEM method. Here, firstly, measurement models were established, and then the first structural model was established. In the measurement model, latent variables or composite variables were measured, while in the structural model, all hypothetical dependencies based on path analysis were tested. Then, insignificant paths in this model were eliminated, new covariances were drawn for reliability tests and the final model was prepared. It is found that all of the indicators of the framework are statistically significant.

The hypotheses presented on the framework were tested using SEM. According to Murari (2015), those between 0.1 and 0.3 for path coefficients indicate a weak relationship, those between 0.3 and 0.5 indicate a moderate relationship, and those between 0.5 and above indicate a strong relationship. If insignificant relationships are rejected, if the intermediate relationship is accepted as partially approved and strong relationships are accepted as approved, the results of the hypothesis in the study can be seen in Table 5.1. Accordingly, the hypothesis that barriers have an effect on inputs was rejected. This shows that the sub-factors presented under the barrier main factor were not considered to be a serious obstacle

by the employees of the construction companies. The hypothesis that the drivers factor has an impact on the inputs factor is approved. As expected, the driving forces listed under the drivers factor direct employees towards organizational learning and thus learning resources. While the hypothesis that enablers has an impact on inputs was partially approved, it was approved with a strong relationship on impacts. This shows that the effectiveness of enablers has a greater direct effect on the impacts of learning at the corporate level, rather than learning resources. As proposed, learning impacts at the corporate level has an impact on benefits at the project level hypothesis approved. Finally, it has been partially approved that inputs indicating learning resources have an impact on corporate level impacts and project level benefits. What draws attention here is that the path coefficient between the inputs and benefits at the project level is slightly higher than the coefficient between the inputs and impacts. From this, it can be deduced that organizational learning resources have more impact on a project basis rather than at an institutional level.

Table 5.1. Results of developed hypothesis

No.	Hypothesis	Result
1	Drivers have a positive effect on inputs	Approved
2	Enablers have a positive effect on inputs	Partially approved
3	Barriers have a negative effect on inputs	Rejected
4	Inputs have a positive effect on impacts	Partially approved
5	Inputs have a positive effect on benefits	Partially approved
6	Impacts have a positive effect on benefits	Approved
7	Enablers have a positive effect on impacts	Approved

5.1. Drivers of Organizational Learning

In Table 4.10, factor loading values of latent variables in the first and final models are shown. When the factor loading values of the variables under the drivers title are examined in the table, it is seen that the driver with the highest point of the organizational learning was government legislation (0.602). Government legislation appears to be a factor pushing construction companies to learn, in line with the concept of rules and regulations, one of the learning resources under the heading of input. This results shows that construction companies in Turkey are significantly derived to learn by government legislations.

The second most prominent variable is changes in business environment (0.588), followed by globalisation (0.575). It can be said that the adaptation to environment is critical for construction companies in Turkey and this adaptation need derives them to learn. In addition, globalisation which can assume as another adaptation level is another significant factor that drives construction companies to learn. After globalisation as fourth most significant factor organizational effectiveness (0.569) comes. Organization's long term survival (0.585) is another driver of organizational learning, The driver point here is to survive in changing conditions by producing better products at a cheaper cost than competitors. Organizations must adapt to circumstances and learn in order to survive over the long run and be competitive and inventive (Barnard, 1938; Lawrence and Dyer, 1983; Lawrence and Lorsch, 1967; Thompson,1967).

Surprisingly, sustainability concerns (0.480) variable, which comes in the eighth place according to the order of mentioning in the scanned literature, comes in the sixth place. We can see from here that another important reason pushing the construction companies in Turkey to organizational learning is sustainability activities. According to study of the Opoku and Fortune (2011), data from their interviews with built environment specialists support the idea that, in order for the construction sector to thrive in the present business climate, organizational learning approaches must embrace sustainability.

Client requirements (0.475) is another driver that construction companies in Turkey learn organizationally in order to fulfill the needs or wishes of the end user. Bishop et al. (2009) also emphasized in his study that the involvement of the customers is critical in the construction process, and in this way, the construction parties learn through collabrative working with each other. Competitive advantage (0.382) comes as the last significant factor as of driver. Here it can be inferred that in order to to stay ahead of their competitors and to protect the company's activities in the long run construction companies in Turkey are intending to organizationally learn.

5.2. Inputs of Organizational Learning

All of the input factors of organizational learning just like the other factors are statistically significant but especially two of them comes ahead of the other ones according

to factor loadings: rules and regulations (0.617) and knowledge transfer among organizational members (0.602). It can be understood from here that the rules and regulations set by authorities such as the state, supervisory board or company level contribute to the organizational learning of companies. Construction organizations learn from different departments, employees, and units within themselves, as well as from other stakeholders throughout the project, as well as students.

Next comes trade shows and exhibitions (0.512) for construction companies in Turkey as an organizational learning resource. Right after it, experience of other organizations (0.503) come as a learning input. In addition, it is seen that R&D (0.484) studies contribute significantly to organizational learning, as expected. Next comes partners (0.477) for construction companies in Turkey as an organizational learning resource. It can be said that partnership in the construction sector contributes to organizational learning in terms of information exchange and collabrative working environment. It definitely seems like everyone agrees that strategic alliances provide firms flexibility and opportunities for innovation and development (Basten and Haamann, 2018; de Bresson and Amesse, 1991; Harrigan and Newman, 1990; Lewis, 1995; Teece, 1992).

Another important organizational input has emerged as learning from other stakeholders (0.468) and acquiring and grafting new members (0.462). In order to utilize from other companies' techniques, expertise, and viewpoints, construction firms may also learn through long or short-term (project-based) collaborations with clients, contractors, suppliers, and other business partners (Ozorhon et al., 2005). Thus it can be inferred that construction companies in Turkey learn from the other organizations most or from their employees by hiring them. Especially in companies where there is no systematic knowledge management or organizational learning process, knowledge is kept implicitly on an individual basis.

As the last inputs of organizational learning organizational routines (0.451) and one’s own experiences (0.321) comes. Organizational routines show the experience gains made by businesses over the years, despite the fact that these advances are not necessarily formalized. The knowledge of the individuals must be incorporated into a non-human repository (transactive memory), such as routines, structures, culture, and strategy, to enable learning at higher levels (Eken et al., 2020; Ozturk et al., 2016; Vera et al., 2015; King et al., 2008;

Love et al., 2000). It is surprising that in the frequency of mention in the examined literature one's own experiences comes first but according to questionnaire survey it comes last as an input in this framework. It can be said that construction companies in Turkey learning from other stakeholders, partners, basically from external sources rather than internal.

5.3. Enablers of Organizational Learning

After a deep literature review as facilitators of organizational learning, 10 factors were listed under the title of enablers in the framework and were voted on by construction company professionals. Depending on the answers given by the company employees, education for individual and organization (0.777) appears as the most important enabler of organizational learning with a significantly high factor loading. According to Murray (2003), the majority of enterprises in the sector place a high priority on individual training, many provide advanced training programs, and training curricula typically correspond with desirable performance and skill levels.

Second comes encouraging personal skills and involvement as an enabler of organizational learning, again with a a close factor loading score (0.760). It can be deduced from this that, parallel to the literature, there is a serious relation between the emphasis on individual contribution within the company and organizational learning. A "climate of openness" inside a company, according to Kululanga et al. (2002), is a setting where workers are free to ask questions and contribute through constructive criticism. This environment creates trust, which encourages creativity and frees staff members from fear and reluctance. Motivational reward systems, job rotations, encouraging individual participation are examples of useful practices to develop personal skills and increase personal involvement.

Goal clarity - shared vision (0.755) and feedback mechanisms (0.743) are found to be highly effective on enablers according to study findings. For organizational learning to occur, there must be circumstances that provide employees a shared awareness of the ways and directions their business must change in order to survive both now and in the future (Kululanga et al., 2001; Baldwin et al., 1997). The common purpose alone is not enough for organizational learning, it is necessary to provide the necessary intermediary tools for this. According to Almaian and Qammaz (2019), by evaluating firms' business processes

quantitatively and/or qualitatively, a firm may track its organizational learning and provide timely feedback on the progress it has made. Another enabler with a score above the 0.7 factor loading point is the top management - leader support factor with a score of 0.734. The idea of leadership is an essential component of knowledge management and learning, according to Stata (1989). Leadership should serve as the change's catalyst since knowledge management asks for it. Leadership is actually an expression of a vision, not merely a matter of personal preference (Kululanga and McCaffer, 2001). Post-project reviews, employee feedback systems, recruiting knowledge workers are examples of useful practices for improving feedback mechanisms.

According to the findings of the questionnaire study, coordination and integration among stakeholders (0.646), knowledge sharing mechanisms (0.618), embracing the change and innovation culture (0.595) appear as other significant enablers. Applications that will ensure cooperation and coordination between different groups, making strategic investments that will enable, facilitate and accelerate knowledge sharing is critical in promoting organizational learning. Given that knowledge is held by several units and persons and that sharing it may be advantageous, coordination and integration across organizational departments and parties involved in the production process are crucial (Almaian and Qammaz, 2019). Just like increasing personal inclusion, cultivating an environment that fosters unorthodox thinking and its application is also critical to promoting organizational learning. It is essential for a company that the business and its environment support the process of collective learning and embrace the innovation culture (Orange et al., 2000).

The last two factors with relatively low factor loading among enablers are partners - collaborative working (0.350) and heterogeneous experience (0.263). These two items appeared as the last two enablers according to the frequency of their mention in the literature studies examined.

5.4. Barriers to Organizational Learning

In this section, the findings of the analysis of the barrier factors in questionnaire study, which lists the factors that hinder organizational learning in the framework prepared, were

examined. Barrier factors have a higher factor loading compared to the factors of other main factors in overall and also contain the factor with the highest factor loading. All factors are rated above 0.5 factor loading and four of the 12 barriers have scores equals to or above the 0.8 factor loading point.

Four most significantly effective factors on barriers are ambigous goals (0.873), lack of top management support (0.800), lack of structured framework for learning (0.816), and rigid and outdated core beliefs, applications (0.800). According to Schilling and Kluge (2009), the lack of clearly defined, measurable goals and performance evaluations is one of the main obstacles to organizational learning. According to Kululanga et al. (2002), a leader who is dedicated to learning fosters organizational learning by initiating a process by which other employees may acquire a similar awareness and knowledge to foster advancement. Not providing adequate atmosphere for innovation, reluctance to change or over confidence of managers are examples of how top management can be a barrier to organizational learning. Contractors miss out on some of the most crucial lessons that could have been learned from projects because there is no set methodology for performing project assessments. Even if the construction industry's business environment has started to update some of its operational processes, the sector still experiences unnecessary knowledge loss (Kululanga et al., 2001). In addition, the results of the study showed that factors such as strict rules and regulations, hierarchy, and monolithic corporate culture also seriously hinder organizational learning. In parallel with these beliefs and practices, the absence of an innovation atmosphere and culture causes organizational learning to fail.

The first four barriers with high factor loading scores are followed by lack of resources (0.783), lack of knowledge to implement innovation (0.775) with close scores. In the study carried out, the concept of resources is specified as budget, time and human resources for learning. Applications of innovation need a certain level of expertise, resources, and understanding. Barlow and Jashapara (1998) justified this by pointing out the youth of many firms in the sector, however according to study results, the same barrier exists for construction companies in Turkey even though 89% of the respondent’s enterprises are older than 21 years.

Lack of organizational structure and culture (0.670) is another barrier to organizational learning. The establishment of teams for projects in construction companies or the high turnover rate at the employee and management level cause a lack of organizational structure. This prevents the transfer of knowledge and these gains forward, knowledge remains at the individual level as an implicit. The organization in charge of completing a building project frequently creates a new team for each product. Due to this frequent interruption of learning and feedback loops (Gann and Salter, 2000), it is difficult to create long-term learning curves in the construction sector (Senaratne and Malewana, 2011). As expected, fragmanted nature of the construction industry (0.585) is a barrier to organizational learning due to its project-based structure, large and complex projects, long processes, conflict of interest, competition with other teams, reluctance to knowledge sharing. The team's size and composition fluctuate during the project (Orange et al., 1999), and generally the fragmented nature of the industry creates barriers to efficient knowledge absorption (Ahankoob et al., 2015).

5.5. Impacts of Organizational Learning

In this section, it is aimed to find out how organizational learning impacts the construction companies in Turkey at the corporate level. According to this aim, the impact with highest factor loading is seen as organizational effectiveness (0.800). This is explained as productivity enhancement, reduced time and cost within the scope of the study. The results of Murray and Chapman's (2003) questionnaire study also shows a positive correlation between an organization's success on construction projects and its capacity for learning (Wong et al., 2012). Three corporate-level impacts follow with similar scores: integration of business processes and participants (0.767), innovation capability improvement (0.746), enhance decision-making abilities (0.737). Integration of business processes and participants were described as encouraging collaboration and open communication, transparent work environment; innovation capability improvement as embracing change culture and being innovation oriented; and enhanced decision-making abilities as collection and storage of past knowledge to exploit for future decisions specified. Organizational learning promotes reflection on how actions affect people and organizations, improved understanding of organizational environments, and more effective decision-making (Bishop et al., 2009; Yang, 2007).

As can be expected, the effects of achieving budget goal (0.661) and adaptation to changing environment (0.640), which appear as the fifth and sixth according to the factor loading scores of seven impacts same with the frequency of mention in the examined literature. Surprisingly, although the competitive advantage (0.558) effect is in the first place according to the frequency of mention in the literature, it is at the lowest level according to the results of the study. However, numerous researchers have looked into how OL could contribute to competitiveness (Senaratne and Malewana, 2011). Organizational learning is the key to comprehending what makes a firm competitive, claim Real et al. (2014).

5.6. Benefits of Organizational Learning

In this section, the benefits of organizational learning on a project basis are examined and listed. According to the findings of the study carried out, it is at the highest level according to the enhanced construction productivity (0.751) factor loading score. This productivity is defined as enhanced units of work placed or produced per man-hour. The second and third topics were similarly reduced time and accurate. If construction businesses want to stay competitive and lessen their dependency on imports, they must consistently improve their efficiency. OL is one of the most significant and long-lasting competitive advantages for raising productivity (Guthrie, 2005; Levitt and March, 1988).

The point to be noted here is that time-related factors score higher than cost factors. Reduced time (733) comes as the second factor with highest factor loading point while accurate timetables is being third with 0.702 factor loading point. Then, reduced cost (0.702) and high quality of final product (0.692) came as project-based benefits of organizational learning. A lack of knowledge management and information exchange in the construction industry has been identified as one of the main causes of problems such as budget overruns, incorrect timetables, and unmet end-user needs (Haapalainen, 2008; Naaranoja and Uden, 2007; Anumba et al., 2005; Love et al., 2004). Finally, although accurate cost estimates (0.632) are at the top according to the mention frequency in the scanned literature, it is in the last place according to factor loading. However, 0.63 factor loading is still a significant score. The knowledge and use of OL in construction organizations may decrease the negative impacts of failing to learn from previous projects, allowing for the achievement of precise cost estimations.

6. CONCLUSIONS

In a rapidly changing and complex environment, construction companies are also looking for many different ways to gain competitive advantage and to show a sustainable presence in the industry for many years. According to many researchers, one of the fundamental mechanisms of competitive advantage and long-term existence is organizational learning. Although the subject of organizational learning in the construction sector is frequently researched and discussed in the literature, a systematic organizational learning structure at the desired level has not been reached yet and there is still a lack of learning culture and tools that support learning (Tan et al., 2010; Ford et al., 2000). The construction industry is multi-layered due to its structure, its projects are complex, its environment is variable and teams are project-based. For all these reasons, the learning model of companies operating in the construction industry is challenging and different compared to companies in the manufacturing industry. The aim of this study is to first create a framework after a comprehensive literature review that covers the whole concept of organizational learning in the construction industry, and to analyze this framework through empirical research. Management scholars, according to Chan et al. (2004), have started to notice the discrepancies between ideas linked to organizational learning in the literature and have brought out the absence of a solid theoretical but, more importantly, empirical base. When organizational learning (OL) in construction organizations is studied, it is evident that conceptual work has a far larger structure than empirical research (Kululanga et al., 2002; Garvin, 1993). After the empirical research of the study, it is aimed to raise awareness to the managers and employees working in the construction industry about the concept of organizational learning, how they can improve their companies, how they can better involve themselves in the learning process, which factors are obstacles and which factors are facilitators in the process.

The study first began with a comprehensive literature review on organizational learning. Then, the literature review was continued in the form of more specific sub-headings such as organizational learning in the construction sector and organizational learning in construction companies in Turkey. There were two main objectives throughout the literature review here, to examine the frameworks and models related to the concept, and to decide on

the factors of this framework. After detailed examination and comparisons, the most comprehensive framework in which the concept can be examined was created. It was based on the model prepared by Framework Ozorhon (2013) to explain the innovation process, and as a result, 6 main components were decided: “drivers”, “inputs”, “enablers”, “barriers”, “impacts”, “benefits”. By reducing the number of academic studies scanned to 48, framework factors were obtained from these academic studies. Although 133 factors appeared as a sub-heading at first, with the help of the academic advisor and two professionals working in the sector, some factors were eliminated and the majority were combined into one main factor, reducing it to 53. Then, the framework factors, which were finalized, were brought into a questionnaire survey format that included questions about the careers and companies of the employees working in the construction sector in Turkey. Employees were asked to evaluate each factor using a survey study in a 1-5 Likert Scale format. In total, 140 answers were collected at first, but after the examinations, it was reduced to 136 after the decision to exclude four answers from the evaluation. The collected data was analyzed with descriptive statistics and structural equation modeling (SEM) analysis methodologies, and the results were discussed in the study and compared with the literature. In this part of the study, all the steps were summarized and limitations, future recommedations were specified.

6.1. Summary of Major Findings and Recommendations

A total of 136 participants working in construction companies in Turkey participated in the prepared framework-based questionnaire survey. Of these employees, 32.4% have 11-20 years of experience, 25.7% have 6-10 years of experience, 24.3% have 21 years or more, and 17.6% have 1-5 years of experience. While 36.3% of the participants are Middle-Level Managers, 25.0% are civil engineers and 15.4% are Top-Level Managers. Majority of the companies of the participants, 96%, stated that they participated in the projects as main contractor and 89% of the companies have 21 or more years of experience in the sector. 96 of them, or 70% of the participants, claim that their companies to have an annual turnover of $100 million or more, while 6 of them, or 5%, claim to have an annual turnover of between $5 and $100 million.

- In this study, firstly enablers and then inputs emerge as core constructs. In addition, drivers have an impact on the inputs with very strong relationship.

- Demands from the construction companies in Turkey as a governmental authority will push the companies to learn in order to survive in the long term. Government in Turkey has a great responsibility for the construction industry to gain competitive advantage, adapt to the changing environment, and increase organizational effectiveness.

- Leaders need to set a common goal, establish feedback mechanisms and knowledge sharing mechanisms in order to increase decision-making capabilities and improve innovation capabilities. Otherwise, they cannot reach the targeted outputs such as budget goals, high quality products, reduced costs.

- In order to increase organizational effectiveness, to adopt a culture of innovation, employees should benefit more from the training provided by companies and be more assertive in demonstrating their personal skills and inclusion.

- Companies aiming for globalization and wanting to fulfill the demands of their customers should aim to increase the integration among their employees and the knowledge transfer between members.

- When looking at the latent variable factor loadings in SEM for learning inputs, the construction companies in Turkey mostly learn from the external resources. Examples of external resources include rules and regulations, experience of other organizations, partners, trade shows. However, organizational routines and companies' own experiences are the last inputs with lower factor loading values in this framework. In this case, it is recommended to improve the relations of construction companies with each other in order to increase organizational learning.

- As an enabler, education for individual and organization comes first according to factor loadings. In this case, the emphasis of the construction companies on organizational and individual training will improve the learning mechanism so that

companies can improve the construction productivity, enhance decision-making capabilities.

- Looking at the average enabler values, top management - leader support comes first. It also has a significant factor loading point. This means that leaders are in a critical position in companies that want to improve their organizational learning.

- Goal clarity - shared vision is in the upper ranks as enabler, while it appears with the highest rank as a barrier. It can be deduced from this that while setting clear goals, sharing this goal with all company units and having a shared vision significantly facilitates organizational learning in construction companies in Turkey, the absence of a common, clear goal also hinders organizational learning with a significantly negative effect.

- When looking at barriers, ambigous goals and lack of top management support factors emerge as the most obvious factors. Next comes lack of structured framework for learning, rigid and outdated core beliefs and applications, lack of resources. From this, it can be concluded that a lack of support and motivation from executive level in construction companies in Turkey significantly affects organizational learning negatively. However, considering the impacts of organizational learning, companies that want to survive in the sector for a long time, gain competitive advantage and increase their effectiveness should pay attention to their managers, structures that support innovation and up-to-date beliefs and applications.

- Those who want to reduce the time and cost in the project processes, or who want to reach the target budget and time tables, should adapt the organizational learning and innovation culture in their companies and provide the necessary tools.

- The results of the survey show that organizational learning significantly improves decision-making abilities. In this way, companies can make more accurate decisions and provide more exploitation than future decisions.

6.2. Study Limitations and Recommendations for Future Research

First of all, the concept of organizational learning is a difficult notion to measure analytically due to its nature. In order to be measured with a quantitative data, the framework was turned into a questionnaire survey for the employees in the sector and the asked them to evaluate the factors. Therefore, a conclusion based on personal experiences and perspective is obtained here. Secondly, the questionnaire prepared to collect data was evaluated only by the employees of construction companies in Turkey. Therefore, there is a geographical limit here and it should be taken into account that the prepared study may give a different result in another geography. Another limit is that the study is based solely on the personal experiences and opinions of the participating professionals. There is no scale that has been tracked and recorded based on any company data or case studies. Another limit is the determination of the factors and components related to the content of the prepared framework based on literature review and expert opinions. Apart from the factors listed here, there may be very important factors that have not been included in the literature or have not been noticed yet.

Future studies may rely on the development of the study by not complying with the stated limitations. Studies can be applied not only in Turkey but also in different geographies and the results can be compared. In future studies, data based on the thoughts and experiences of the employees can be collected at certain intervals throughout a case study, not just all at once. More information on the process review of organizational learning in the industry can be accessed using the case study method. Differently, by determining the criteria that measure the success of the companies, the change of these criteria can be monitored with the concept of organizational learning rather than only the experts opinion. Finally, the components and factors in the prepared framework can be differentiated, diversified and improved.

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APPENDIX A: QUESTIONNAIRE SURVEY

A.1. Background Reading

Organizational learning (OL) is defined as “the systematic promotion of a learning culture within an organization such that employees at all levels, individually and collectively, continually increase their capacity to improve their level of performance” by Kululanga et al. (2001). Organizational learning is considered as fundamental building block of competitive advantage and productivity improvement.

Many industries realized the importance of Organizational Learning and embraced it as an indispensable part of their organizational strategies. One of the main goals of a company in any industry is to benefit as much as possible from the experience and knowledge gained from the work it does, and to use it to increase the efficiency of its productivity in the future, whether it is routine-based or project-based. This situation leads to differences in how companies in different sectors can perform Organizational Learning activities and how much they can benefit from it. For example, the Information Management practices and challenges implemented by a company in the routine-based production sector are not the same as the practices and difficulties faced by a company in the project-based construction sector.

In the construction industry, each project is unique, so the problems are special, nature of the sector is fragmanted, team structures are project-based and activities are discontinued. Construction industry organizations have to overcome many different challenges and develop different methods in OL activities because they cannot develop routine-based activities as in manufacturing sector. The main purpose of this study is to propose a comprehensive framework for Organizational Learning (OL) in the Turkish AEC (Architectural, Engineering, Construction) industry.

A.2. General Information

1. Please indicate how many years of experience you have in the AEC (Architectural, Engineering, Construction) industry

   ☐ 1 - 5 years
   ☐ 6 - 10 years
   ☐ 11 - 20 years
   ☐ 21 - or more years

2. Please indicate your position in your company

   ☐ Top Level Management (Board of Directors, Chief Executive Officer, General Manager, Managing Director, Project Manager, etc.)
   ☐ Middle Level Management (Department Head, Branch Manager, Junior Executives, etc.)
   ☐ Engineer
   ☐ Architect
   ☐ MEP Engineer
   ☐ Technician
   ☐ Other (……..)

3. Please specify your company's field(s) of operation

   ☐ Commercial buildings (offices, warehouses, shopping centers, hotels, etc.)
   ☐ Residential buildings (single and multi-family homes)
   ☐ Industrial facilities (factories, plants, large-scale production facilities, etc.)
   ☐ Infrastructure projects (roads, bridges, airports, or sewer systems, etc.)
   ☐ Other (……..)

4. Please indicate in which main business area your company operates

   ☐ Owner / Client
   ☐ Investor / Partner
   ☐ Main Contractor
   ☐ Subcontractor
   ☐ Design (Architecture / Structure / MEP Eng.)
   ☐ Supplier / Vendor
   ☐ Consultancy
   ☐ Other (……..)

5. Please indicate how many years of experience your company has in this area

☐ 1 - 5 years
☐ 6 - 10 years
☐ 11 - 20 years
☐ 21 - or more years

6. Please indicate approximately how many people work in your company

☐ 1 - 10
☐ 11 - 50
☐ 51 - 100
☐ 101 - 500
☐ 500 - or more

7. Please indicate the approximate annual turnover of your company in USD ($)

☐ 1 million or less
☐ 2 million – 10 million
☐ 10 million – 50 million
☐ 50 million – 100 million
☐ 100 million or more
☐ I do not know

A.3. Factors of Organizational Learning in Construction Industry

Please state the importance level of listed factors based on the question above table.

1. To what extent do you agree/disagree with the following factors in creating the organizational learning need?

	Table A.1. Drivers of Organizational Learning	**Very Low**	**Low**	**Medium**	**High**	**Very High**
1	Organizational effectiveness					
2	Competitive advantage					
3	Organization's long term survival					
4	Changes in the business environment					

5	Client requirements					
6	Government legislation					
7	Globalisation					
8	Sustainability concerns					

2. To what extent do you agree/disagree with the following factors about being a resource for organizational learning?

	Table A.2. Inputs of Organizational Learning	**Very Low**	**Low**	**Medium**	**High**	**Very High**
1	One's own experiences					
2	Knowledge transfer among organizational members					
3	Experience of other organizations					
4	Research and development (R&D)					
5	Organizational routines					
6	Learning from other stakeholders - collabrative working					
7	Partners					
8	Rules and regulations					
9	Acquiring and grafting new members					
10	Trade shows and exhibitions					

3. To what extent do you agree/disagree with the following factors regarding the promotion of organizational learning?

	Table A.3. Enablers of Organizational Learning	**Very Low**	**Low**	**Medium**	**High**	**Very High**
1	Embracing the change and innovation culture					
2	Knowledge sharing mechanisms					
3	Coordination and integration among stakeholders					
4	Top management - leader support					

5	Goal clarity - shared vision					
6	Encouraging personal skills and involvement					
7	Education for individual and organization					
8	Feedback mechanisms					
9	Partners - collaborative working					
10	Heterogeneous experience					

4. To what extent do you agree/disagree with the following factors regarding the barriers to organizational learning?

	Table A.4. Barriers to Organizational Learning	**Very Low**	**Low**	**Medium**	**High**	**Very High**
1	Lack of participation and communication					
2	Lack of organizational structure and culture					
3	Lack of innovation culture					
4	Complex and changing environment					
5	Fragmented nature of the industry					
6	Rigid and outdated core beliefs, applications					
7	Lack of top management support					
8	Ambigous goals					
9	Lack of resources					
10	Lack of structured framework for learning					
11	Lack of knowledge to implement innovation					
12	Lack of well-trained human resources in the sector					

5. To what extent do you agree/disagree with the following factors regarding the benefits of organizational learning at the project level?

	Table A.5. Benefits of Organizational Learning	**Very Low**	**Low**	**Medium**	**High**	**Very High**
1	Accurate cost estimates					
2	Reduced costs					
3	Accurate timetables					
4	Reduced time					
5	High quality of final product					
6	Enhanced construction productivity					

6. To what extent do you agree/disagree with the following factors regarding the impacts of organizational learning at the organizational level?

	Table A.6. Impacts of Organizational Learning	**Very Low**	**Low**	**Medium**	**High**	**Very High**
1	Competitive advantage					
2	Integration of business processes and participants					
3	Enhance decision-making abilities					
4	Organizational effectiveness					
5	Innovation capability improvement					
6	Achieving budget goal					
7	Adaptation to changing environment					

APPENDIX B: LITERATURE REVIEW

Table B.1. Literature review on drivers of organizational learning.

| No | Literature Source | | |

Table B.2. Literature review on inputs of organizational learning.

| No | Literature Source | | |

Table B.3. Literature review on enablers of organizational learning.

| No | Literature Source | | |

Table B.4. Literature review on barriers to organizational learning.

| No | Literature Source | | |

Table B.5. Literature review on corporate level impacts of organizational learning.

| No | Literature Source | | |

Table B.6. Literature review on project level benefits of organizational learning.

| No | Literature Source | | |

APPENDIX C: DESCRIPTIVE STATISTICS

Table C.1. Descriptive statistics of general information about respondents and their companies.

Descriptive Statistics	Employee Experience	Employee Position	Type of Projects
N	136	136	136
Mean	2,63	3,06	3,11
Median	3	2	3
Std. Deviation	1,04	1,87	0,86
Kurtosis	-1,12	0,13	0,29
Skewness	-0,18	1,12	-0,02
Range	3	6	4
Minimum	1	1	1
Maximum	4	7	5
Values of Variables	1: 1 - 5 Years 2: 6 - 10 Years 3: 11 - 20 Years 4: 21 - or more	1: Top-Level Management 2: Mid-Level Management 3: Civil Engineer 4: Architect 5: MEP Engineer 6: Technician 7: Others	1: Commercial projects 2: Residential projects 3: Industrial projects 4: Infrastructure projects 5: Others

Table C.2. Descriptive statistics of general information about respondents' companies.

Descriptive Statistics	Organization's Business Areas	Organization Experience	Number of Employees	Annual Turnover (USD)
N	136	136	136	136
Mean	3,04	3,81	4,84	5,06
Median	3	4	5	5
Std. Deviation	0,67	0,61	0,56	0,79
Kurtosis	1,34	12,36	24,58	11,02
Skewness	0,40	-3,55	-4,64	-2,51
Range	4	3	4	5
Minimum	1	1	1	1
Maximum	5	4	5	6
Values of Variables	1: Client/Owner 2: Investor / Partner 3: Main Contractor 4: Subcontractor 5: Design 6: Supplier / Vendor 7: Consultancy 8: Others	1: 1 - 5 Years 2: 6 - 10 Years 3: 11 - 20 Years 4: 21 - or more	1: 1 - 10 2: 11 - 50 3: 51 - 100 4: 101 - 500 5: 501 - or more	1: $ 1Mn or less 2: $ 2Mn - $ 10Mn 3: $ 10Mn - $ 50Mn 4: $ 50Mn - $ 100Mn 5: $ 100Mn or more 6: I do not know

Table C.3. Descriptive statistics of organizational learning drivers.

	N	Mean	Median	Std. Deviation	Kurtosis	Skewness	Range	Minimum	Maximum
D1	136	4,14	4	0,88	0,84	-1,01	4	1	5
D2	136	3,96	4	0,97	0,03	-0,72	4	1	5
D3	136	4,13	4	0,89	0,81	-1,03	4	1	5
D4	136	4,04	4	0,87	-0,25	-0,64	3	2	5
D5	136	4,05	4	0,91	-0,07	-0,69	4	1	5
D6	136	3,77	4	1,04	-0,50	-0,41	4	1	5
D7	136	4,07	4	0,93	-0,05	-0,76	4	1	5
D8	136	3,82	4	1,12	-0,28	-0,70	4	1	5

Drivers: D1: Organizational effectiveness, D2: Competitive advantage, D3: Organization's long-term survival, D4: Changes in the business environment, D5: Client requirements, D6: Government legislation, D7: Globalisation, D8: Sustainability concerns

Table C.4. Descriptive statistics of organizational learning inputs.

	N	Mean	Median	Std. Deviation	Kurtosis	Skewness	Range	Minimum	Maximum
I1	136	4,51	5	0,69	1,52	-1,34	3	2	5
I2	136	4,35	5	0,79	2,23	-1,35	4	1	5
I3	136	3,61	4	0,90	-0,49	-0,06	4	1	5
I4	136	3,84	4	1,08	-0,50	-0,58	4	1	5
I5	136	3,79	4	0,93	-0,04	-0,48	4	1	5
I6	136	3,96	4	0,82	1,27	-0,75	4	1	5
I7	136	3,68	4	1,01	-0,12	-0,49	4	1	5
I8	136	3,75	4	0,99	-0,57	-0,30	4	1	5
I9	136	3,86	4	0,94	1,04	-0,95	4	1	5
I10	136	3,18	3	1,15	-0,75	0,14	4	1	5

Inputs: I1: One’s own experiences, I2: Knowledge transfer among organizational members, I3: Experience of other organizations, I4: Research and development (R&D), I5: Organizational routines, I6: Learning from other stakeholders - collabrative working, I7: Partners, I8: Rules and regulations, I9: Acquiring and grafting new members, I10: Trade shows and exhibitions

Table C.5. Descriptive statistics of organizational learning enablers.

	N	Mean	Median	Std. Deviation	Kurtosis	Skewness	Range	Minimum	Maximum
E1	136	4,13	4	0,89	1,12	-1,02	4	1	5
E2	136	4,31	4,5	0,83	1,35	-1,19	4	1	5
E3	136	4,18	4	0,82	-0,36	-0,66	3	2	5
E4	136	4,51	5	0,76	1,47	-1,49	3	2	5
E5	136	4,29	4	0,84	1,06	-1,11	4	1	5
E6	136	4,21	4	0,93	1,26	-1,21	4	1	5
E7	136	4,01	4	0,93	0,27	-0,74	4	1	5
E8	136	4,10	4	0,98	0,57	-0,96	4	1	5
E9	136	3,30	3	0,99	-0,19	-0,22	4	1	5
E10	136	3,70	4	1,00	-0,33	-0,36	4	1	5

Enablers: E1: Embracing the change and innovation culture, E2: Knowledge sharing mechanisms, E3: Coordination and integration among stakeholders, E4: Top management - leader support, E5: Goal clarity - shared vision, E6: Encouraging personal skills and involvement, E7: Education for individual and organization, E8: Feedback mechanisms, E9: Partners - collaborative working, E10: Heterogeneous experience

Table C.6. Descriptive statistics of organizational learning impacts at the corporate level.

	N	Mean	Median	Std. Deviation	Kurtosis	Skewness	Range	Minimum	Maximum
IM1	136	4,31	5	0,93	3,06	-1,66	4	1	5
IM2	136	4,01	4	1,05	1,04	-1,13	4	1	5
IM3	136	4,23	4	0,91	1,66	-1,31	4	1	5
IM4	136	3,86	4	1,10	0,36	-0,93	4	1	5
IM5	136	3,97	4	1,04	0,03	-0,82	4	1	5
IM6	136	4,26	4	0,91	1,61	-1,31	4	1	5
IM7	136	3,99	4	0,90	-0,70	-0,46	3	2	5

Impacts: IM1: Competitive advantage, IM2: Integration of business processes and participants, IM3: Enhance decision-making abilities, IM4: Organizational effectiveness, IM5: Achieving budget goal, IM6: Adaptation to changing environment, IM7: Innovation capability improvement

Table C.7. Descriptive statistics of barriers to organizational learning.

	N	Mean	Median	Std. Deviation	Kurtosis	Skewness	Range	Minimum	Maximum
B1	136	4,04	4	1,07	0,68	-1,09	4	1	5
B2	136	3,99	4	1,08	0,69	-1,06	4	1	5
B3	136	3,75	4	1,09	0,21	-0,82	4	1	5
B4	136	3,38	3	1,14	-0,74	-0,18	4	1	5
B5	136	3,62	4	1,08	-0,21	-0,56	4	1	5
B6	136	3,91	4	1,20	0,06	-0,95	4	1	5
B7	136	4,22	5	1,13	1,65	-1,52	4	1	5
B8	136	4,01	4	1,14	0,25	-1,02	4	1	5
B9	136	4,13	4,5	1,09	0,80	-1,23	4	1	5
B10	136	3,93	4	1,07	0,64	-1,01	4	1	5
B11	136	3,79	4	1,07	0,48	-0,92	4	1	5
B12	136	3,82	4	1,21	-0,09	-0,86	4	1	5

Barriers: B1: Lack of participation and communication, B2: Lack of organizational structure and culture, B3: Lack of innovation culture, B4: Complex and changing environment, B5: Fragmented nature of the industry, B6: Rigid and outdated core beliefs, applications, B7: Lack of top management support, B8: Ambigous goals, B9: Lack of resources, B10: Lack of structured framework for learning, B11: Lack of knowledge to implement innovation, B12: Lack of well-trained human resources in the sector

Table C.8. Descriptive statistics of organizational learning benefits at the project level.

	N	Mean	Median	Std. Deviation	Kurtosis	Skewness	Range	Minimum	Maximum
BE1	136	4,04	4	0,86	0,95	-0,94	4	1	5
BE2	136	4,24	4	0,84	1,20	-1,08	4	1	5
BE3	136	4,21	4	0,84	1,21	-1,08	4	1	5
BE4	136	4,04	4	0,87	0,79	-0,91	4	1	5
BE5	136	4,20	4	0,86	-0,11	-0,82	3	2	5
BE6	136	4,13	4	0,86	-0,51	-0,60	3	2	5

Benefits: BE1: Accurate cost estimates, BE2: Reduced costs, BE3: Accurate timetables, BE4: Reduced time, BE5: High quality of final product, BE6: Enhanced construction productivity

APPENDIX D: CORRELATION MATRICES

Table D.1. Correlation matrix of organizational learning drivers.

	D1	D2	D3	D4	D5	D6	D7	D8
D1	1							
D2	.258**	1						
D3	.363**	.237**	1					
D4	.302**	.231**	.241**	1				
D5	.194*	.295**	0,155	.315**	1			
D6	.319**	.190*	.312**	.340**	.371**	1		
D7	.295**	.249**	.380**	.380**	.213*	.300**	1	
D8	.260**	0,090	.418**	.291**	.198*	.276**	.447**	1

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

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

Drivers: D1: Organizational effectiveness, D2: Competitive advantage, D3: Organization's long-term survival, D4: Changes in the business environment, D5: Client requirements, D6: Government legislation, D7: Globalisation, D8: Sustainability concerns

Table D.2. Correlation matrix of organizational learning inputs.

	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10
I1	1									
I2	.456**	1								
I3	0,130	.400**	1							
I4	0,132	.319**	.483**	1						
I5	0,165	.270**	.319**	.397**	1					
I6	.265**	.265**	.288**	.296**	.321**	1				
I7	.195*	.264**	.348**	.306**	.331**	.549**	1			
I8	0,154	.300**	.311**	.308**	.417**	.288**	.354**	1		
I9	.258**	.284**	0,144	.211*	.170*	.377**	.356**	.420**	1	
I10	0,143	.277**	.283**	.515**	.258**	.270**	.173*	.397**	.372**	1

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

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

Inputs: I1: One's own experiences, I2: Knowledge transfer among organizational members, I3: Experience of other organizations, I4: Research and development (R&D), I5: Organizational routines, I6: Learning from other stakeholders - collaborative working, I7: Partners, I8: Rules and regulations, I9: Acquiring and grafting new members, I10: Trade shows and exhibitions

Table D.3. Correlation matrix of organizational learning enablers.

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10
E1	1									
E2	.659**	1								
E3	.535**	.526**	1							
E4	.342**	.462**	.504**	1						
E5	.357**	.296**	.470**	.554**	1					
E6	.381**	.417**	.436**	.615**	.606**	1				
E7	.455**	.448**	.529**	.518**	.564**	.650**	1			
E8	.513**	.446**	.446**	.530**	.406**	.524**	.616**	1		
E9	.318**	.336**	.279**	.245**	.348**	.351**	.391**	.466**	1	
E10	.410**	.328**	.308**	.235**	.244**	.315**	.313**	.446**	.534**	1

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

Enablers: E1: Embracing the change and innovation culture, E2: Knowledge sharing mechanisms, E3: Coordination and integration among stakeholders, E4: Top management - leader support, E5: Goal clarity - shared vision, E6: Encouraging personal skills and involvement, E7: Education for individual and organization, E8: Feedback mechanisms, E9: Partners - collaborative working, E10: Heterogeneous experience

Table D.4. Correlation matrix of barriers to organizational learning.

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12
B1	1											
B2	.663**	1										
B3	.437**	.517**	1									
B4	.292**	.305**	.486**	1								
B5	.473**	.470**	.425**	.472**	1							
B6	.552**	.605**	.561**	.459**	.490**	1						
B7	.626**	.593**	.620**	.420**	.474**	.693**	1					
B8	.548**	.537**	.504**	.513**	.480**	.699**	.772**	1				
B9	.553**	.516**	.452**	.394**	.446**	.629**	.673**	.725**	1			
B10	.537**	.580**	.707**	.434**	.480**	.678**	.723**	.703**	.599**	1		
B11	.430**	.467**	.578**	.433**	.430**	.584**	.659**	.657**	.612**	.674**	1	
B12	.476**	.418**	.319**	.337**	.474**	.477**	.545**	.559**	.577**	.488**	.597**	1

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

Barriers: B1: Lack of participation and communication, B2: Lack of organizational structure and culture, B3: Lack of innovation culture, B4: Complex and changing environment, B5: Fragmented nature of the industry, B6: Rigid and outdated core beliefs, applications, B7: Lack of top management support, B8: Ambigous goals, B9: Lack of resources, B10: Lack of structured framework for learning, B11: Lack of knowledge to implement innovation, B12: Lack of well-trained human resources in the sector

Table D.5. Correlation matrix of organizational learning impacts at the corporate level.

	BE1	BE2	BE3	BE4	BE5	BE6
BE1	1					
BE2	.542**	1				
BE3	.720**	.556**	1			
BE4	.432**	.605**	.496**	1		
BE5	.384**	.422**	.445**	.500**	1	
BE6	.500**	.516**	.545**	.611**	.540**	1
**. Correlation is significant at the 0.01 level (2-tailed).						
Benefits: BE1: Accurate cost estimates, BE2: Reduced costs, BE3: Accurate timetables, BE4: Reduced time, BE5: High quality of final product, BE6: Enhanced construction productivity						

Table D.6. Correlation matrix of organizational learning benefits at the project level.

	IM1	IM2	IM3	IM4	IM5	IM6	IM7
IM1	1						
IM2	.500**	1					
IM3	.476**	.630**	1				
IM4	.412**	.656**	.728**	1			
IM5	.398**	.566**	.587**	.634**	1		
IM6	.424**	.534**	.450**	.546**	.495**	1	
IM7	.386**	.459**	.404**	.477**	.561**	.601**	1
**. Correlation is significant at the 0.01 level (2-tailed).							
Impacts: IM1: Competitive advantage, IM2: Integration of business processes and participants, IM3: Enhance decision-making abilities, IM4: Organizational effectiveness, IM5: Achieving budget goal, IM6: Adaptation to changing environment, IM7: Innovation capability improvement							