PROJECT-BASED INNOVATION PERFORMANCE ASSESSMENT IN THE HOUSING SECTOR: A CASE STUDY USING INNOVATION RADAR

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

PINAR BILGIN

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
CIVIL ENGINEERING

JULY 2019

Approval of the thesis:

PROJECT-BASED INNOVATION PERFORMANCE ASSESSMENT IN THE HOUSING SECTOR: A CASE STUDY USING INNOVATION RADAR

submitted by **PINAR BILGIN** in partial fulfillment of the requirements for the degree of **Master of Science in Civil Engineering Department, Middle East Technical University** by,

Prof. Dr. Halil Kalıpçılar
Dean, Graduate School of **Natural and Applied Sciences** _____

Prof. Dr. Ahmet Türer
Head of Department, **Civil Engineering** _____

Prof. Dr. İrem Dikmen Toker
Supervisor, **Civil Engineering, METU** _____

Prof. Dr. Mustafa Talat Birgönül
Co-Supervisor, **Civil Engineering, METU** _____

Examining Committee Members:

Prof. Dr. Mustafa Talat Birgönül
Civil Engineering, METU _____

Prof. Dr. İrem Dikmen Toker
Civil Engineering, METU _____

Assist. Prof. Dr. Güzide Atasoy Özcan
Civil Engineering, METU _____

Assist. Prof. Dr. Onur Behzat Tokdemir
Civil Engineering, METU _____

Assist. Prof. Dr. Gözde Bilgin
Civil Engineering, Başkent University _____

Date: 04.07.2019

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Surname: Pınar Bilgin

Signature:

ABSTRACT

PROJECT-BASED INNOVATION PERFORMANCE ASSESSMENT IN THE HOUSING SECTOR: A CASE STUDY USING INNOVATION RADAR

Bilgin, Pınar
Master of Science, Civil Engineering
Supervisor: Prof. Dr. İrem Dikmen Toker
Co-Supervisor: Prof. Dr. Mustafa Talat Birgönül

July 2019, 122 pages

Construction industry is one of the industries that makes a significant contribution to the national development and the economy of the countries. Besides, the low entry barriers as well as the rapid developments in the communication and information technologies make construction industry highly competitive. Therefore, construction companies are forced to differentiate and improve their operations by innovating in different fields to improve or at least to maintain their positions in the market. However, innovation investments require considerable amount of time and money, therefore, the performance of these investments should be assessed like other investments. As a result of in-depth literature review, it was revealed that available frameworks are not appropriate to assess the actual innovation performance of the construction projects at the project level. In this research, Innovation Catcher (IC) was developed as an innovation performance assessment framework that can be used to assess the innovations in the housing projects at the project level. Based on the findings from the literature the dimensions of Innovation Radar (IR) that is previously available model in the literature were modified specifically for the housing sector. The usability of IC was tested on 5 sample projects of a company by conducting a case study. 5 semi-structured interviews were carried out with an expert to collect data

about the sample projects. In the light of these data, IC profiles of sample projects were drawn and the benefits, possible usage areas and improvements were discussed with the expert. As a result, it was concluded that IC is capable of reflecting the actual innovation performance of the housing projects at the project level and can be used as a supportive material in the documentation and decision making processes.

Keywords: Innovation Performance Assessment, Innovation Radar, Innovation in the Construction Industry, Innovation Catcher

ÖZ

KONUT SEKTÖRÜNDE PROJE BAZLI İNOVASYON PERFORMANSI DEĞERLENDİRMESİ: İNOVASYON RADARI KULLANARAK BİR VAKA İNCELEMESİ

Bilgin, Pınar
Yüksek Lisans, İnşaat Mühendisliği
Tez Danışmanı: Prof. Dr. İrem Dikmen Toker
Ortak Tez Danışmanı: Prof. Dr. Mustafa Talat Birgönül

Temmuz 2019, 122 sayfa

İnşaat sektörü, ulusal kalkınmaya ve ülke ekonomisine önemli katkı sağlayan sektörlerden biridir. Ancak, sektörün düşük giriş engellerinin yanı sıra iletişim ve bilgi teknolojilerindeki hızlı gelişmeler inşaat sektörünü oldukça rekabetçi kılmaktadır. Bu nedenle inşaat şirketleri, pazardaki konumlarını iyileştirebilmek veya en azından mevcut durumlarını sürdürebilmek için farklı alanlarda inovasyonlar yaparak faaliyetlerini farklılaştırmak ve iyileştirmek zorunda kalırlar. Bununla birlikte, inovasyon yatırımları önemli miktarda zaman ve para gerektirmekte ve diğer yatırımlarda olduğu gibi, bu yatırımların da performansı değerlendirilmelidir. Detaylı literatür taramasının sonucunda, inşaat projelerinin gerçek inovasyon performansını proje düzeyinde değerlendirmek için mevcut modellerin uygun olmadığı ortaya çıkmıştır. Bu araştırmada, daha önce literatürde mevcut olan İnovasyon Radarına (IR) dayanarak, konut projelerindeki inovasyonları proje seviyesinde değerlendirmek için kullanılabilecek bir inovasyon performansı değerlendirme modeli olan İnovasyon Yakalayıcı (IC) geliştirilmiştir. IC oluşturulurken literatürden elde edilen bulgulara dayanarak, IR'nin bileşenleri konut sektörüne özgülenecek şekilde düzenlenmiştir. IC'nin kullanılabilirliği, vaka incelemesi ile bir inşaat şirketinin 5 örnek projesinde test edilmiştir. Örnek projeler ile ilgili veri toplanması için bir uzman ile 5 adet yarı

yapılandırılmış görüşme yapılmış ve bu verilere dayanarak örnek projelerin IC profilleri çizilmiş ve IC'nin faydaları, olası kullanım alanları ve gerekli geliştirmeler uzman ile tartışılmıştır. Çalışma sonunda, IC'nin konut projelerinin proje seviyesinde gerçek inovasyon performanslarını yansıtabildiği ve projelerin dökümantasyon ve karar verme süreçlerinde etkili bir destekleyici araç olarak kullanılabileceği sonucuna varılmıştır.

Anahtar Kelimeler: İnovasyon Performansı Değerlendirmesi, İnovasyon Radarı, İnşaat Sektöründe İnovasyon, İnovasyon Yakalayıcı

To my beloved family …

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to my thesis advisors Prof. Dr. İrem Dikmen Toker and Prof. Dr. Mustafa Talat Birgönül for their encouragement, guidance, and invaluable help throughout my research.

I must express my gratitude to Su Korkmaz for her support and patience. This accomplishment would not have been possible without her invaluable support.

I want to thank also my colleagues Berhan Melek, Melih Kenanoğlu and Burak Akbaş from Atılım University, Gizem Bilgin, Beste Özyurt, Hüseyin Erol, Görkem Eken, Murat Altun and Başak Seyisoğlu from Middle East Technical University for encouraging me and guiding me with their experiences. I also thank them for their endless emotional support.

Finally, I must express my very profound gratitude to my parents Gül Bilgin and Gürbüz Bilgin, my sister İlsu Bilgin and my grandparents Sabahat Çakar and İlhan Çakar for providing me with unfailing support, endless love and continuous encouragement throughout my life and years of study. I want to thank also Oğuz Tengilimoğlu for his endless support and encouragement.

I dedicated this study in memory of my grandfather Avni Bilgin.

TABLE OF CONTENTS

LIST OF TABLES

TABLES

LIST OF FIGURES

FIGURES

LIST OF ABBREVIATIONS

ABBREVIATIONS

BCG: The Boston Consulting Group

DB: Design Build

DBB: Design Bid Build

GDP: Gross Domestic Product

IC: Innovation Catcher

ICT: Information and Communication Technologies

IPA: Innovation Performance Assessment

IR: Innovation Radar

IT: Information Technology

IVC: Innovation Value Chain

IWB: Innovative Work Behavior

KPI: Key Performance Indicator

OECD: Organization for Economic Co-operation and Development

R&D: Research and Development

ROI: Return on Investment

CHAPTER 1

INTRODUCTION

Innovation is an abstract concept that has attracted the attention of many scholars since its first introduction in the literature as “creative destruction” by Joseph Schumpeter. In order to understand this abstract concept, different definitions and classifications have been proposed by many researchers. Despite the differences in these definitions, most of them are shaped around two ideas: 1) creation or adoption of a new idea and 2) commercial use of these new ideas. In addition to these two common facts, most of the definitions in the literature provide a comprehensive and wide perspective. However, when it comes to practice, there is a general understanding that innovation is only associated with research and development (R&D). Although the outputs of R&D studies constitute an important part of innovative ideas in the technology-driven industries, in more traditional industries this understanding becomes inadequate to define innovation.

The construction industry can be classified as a traditional industry where high-tech applications are not intense, and the operations are mostly based on the labor force. Also, it is considered as the leading sector in most of the countries. It is one of the industries that have a significant effect on the economy and the national development of countries. In addition to its own employment potential, with its subsectors and related industries, the construction industry constitutes a considerable part of the total employment. When the effects of the construction industry on nations’ economy and development and unique characteristics of the construction industry are taken into consideration, special attention is required to explore the innovation concept in this industry.

With the increasing competition in the construction industry, innovation has gained importance more and more. The advancements in technology in the past decades have caused the creation of a competitive environment in the construction industry. Therefore, differentiating their products in many different ways has become essential for the construction companies to survive in such a competitive environment. Another reason for increased competition is the increase in the number of construction companies due to the low entry barriers in the construction industry. It has affected the construction industry in two ways; first, due to the low standards, while the number of construction companies has increased, the quality of these companies has decreased. Secondly, the existence of a high number of contractors in the market has resulted in the creation of an intensely competitive environment. In these situations, to improve the quality of their work and to be realized among the high number of competitors, innovation has become a must for the construction companies.

With the increasing awareness about the importance of innovation in the construction industry, construction companies have increased their attempt to invest in innovation activities. However, innovation investments require a considerable amount of money, and success cannot be guaranteed. Therefore, there is a need to assess the performance of these investments. In this study, the requirement and possible benefits of innovation performance assessment (IPA) in the construction industry are discussed. Within the context of this study, it is aimed to develop an IPA framework for the housing sector that can be practically used in the industry. In the initial stage of the study, an appropriate IPA model was selected from the literature. Then in the light of the findings from the literature view, this model was modified for use in the housing sector. When the framework was created, broadening the innovation perspective in the construction industry was ensured by considering the multiple innovation fields.

In order to catch as many innovations as possible in the construction sites where most of the innovations disappear, the assessor is guided by identifying possible innovation fields on Innovation Catcher (IC). These fields constitute the dimensions of the IC.

The content of each dimension is defined and exemplified in the interview form to create a clear understanding.

This thesis presents the findings of the multiple semi-structured interviews with one of the most well-known contractors in Turkey. The company was established in 1969 as a construction company. In addition to the construction industry, today, the company carries out its activities in different industries such as tourism, service, manufacturing, and insurance. The expert from the company contributed to the study by providing data about sample projects as well as sharing her experiences within the interview sessions. In the case study, the general innovation perspective of construction companies and IPA methods were discussed and proposed IPA framework, which is IC was applied to the sample projects. But, the major focus of the study was to test the applicability of the IC in practice.

The following organization is adopted within this thesis. In Chapter 2, the literature review on innovation is presented. The definition of innovation, different innovation classifications, discussions about innovation as a source of competitive advantage, how to manage innovation, and literature on innovation assessment are discussed. Chapter 3 covers the literature review on innovation in the construction industry. In this chapter concept of innovation in the construction is investigated, and barriers and drivers of innovation in the construction industry are revealed. Also, innovation assessment practices in the construction industry are discussed. Chapter 4 continues with the research objective and aims and research methodology. In this respect, the steps in the methodology are explained. In Chapter 5, the proposed framework and its dimensions are presented and discussed in an elaborative expression. Chapter 6 introduces the case study and general information about the study, company, and company interviews. Chapter 7 presents the research findings. In Chapter 8, the results of the testing interview and expert recommendations are presented. Finally, Chapter 9 concludes the study by highlighting the major findings, discussing the research limitations, and making recommendations for future studies. In addition to the main text, the sample interview form is included in the appendix section.

CHAPTER 2

INNOVATION

2.1. Definition of Innovation

In the literature, scholars have defined innovation in many different ways. For example, it is defined as the realization of a change that is new for an organization or its environment (Knight, as cited in Becker & Whisler, 1967); the successful implementation of creative ideas (Amabile, 1997; Sexton and Barrett, 2003b); implementation of new product, process or managerial practices to increase the effectiveness or efficiency (Seaden et al. 2003); a process that involves new idea generation and implementation of these ideas within an organization (Wan et al. 2005). U.S. Department of Commerce (DOC as cited in Rose et al. 2009) provides more comprehensive definition and describes innovation as "design, development, and implementation of new or altered products, services, processes, organizational structures, and business models to create value for the customer and financial returns for the firm practicing innovation.

The innovation theorist Joseph Schumpeter has had a considerable effect on the innovation literature. According to Schumpeter (1934), in the innovation process, the old is continuously destroyed while the new is continuously created. He called this process "creative destruction," and stated that economic development is driven by this process (OECD, 2005). In his works, he emphasized that the distinction between invention and innovation should be made (Schumpeter, 1947). While the invention can be defined as the first generation of an idea, in order to regard an idea as an innovation, it should be commercialized and add value to the company (Fagerberg, 2009; Van de Ven et al., 1986). According to Slaughter (1998), the commercial use of the idea differentiates innovation from invention. Likewise, Sexton and Barrett

(2003a) state that the successful implementation of the idea is the major difference between these two concepts. Therefore, it can be said that innovation consists of both the invention and implementation of the invention (Gambatese & Hallowell, 2011).

In this study, the definition of innovation provided by OECD (Organization for Economic Cooperation and Development) was taken as the primary reference. In Oslo manual prepared by OECD (2005), innovation is defined as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations."

In order to provide a clear definition of innovation the following question should be answered: If the company uses an idea that was previously developed by another company for the first time, can it still be regarded as an innovation? According to the Oslo Manual, as long as the product, process, marketing methods or organizational practices are new or significantly improved the company, it can be considered as an innovation (OECD 2005). According to Barata and Fontainha (2017), innovation may be realized at the world level, national level, industry level or the firm level. Also, many scholars (Tushman and Nadler, 1986; Slaughter, 1998; Sexton and Barrett, 2003b; Kulatunga et al. 2006; Barrett et al. 2008) emphasize the minimum requirement of innovation as "new to a business unit or a firm" in their definitions. In his works, Schumpeter called the first developer of the idea "the innovator," and the others that use the idea in their companies for the first time "the imitator." Although Pérez-Luño et al. (2007) separated the innovator and imitator in their definitions distinctly, based on Schumpeter's definition of innovation both the former and the latter can be regarded as an innovator (Fagerberg, 2009). Because, even though the company is not the first developer of the idea, actually the company innovates by implementing this innovation in its own way, in a new context and creating value for itself.

A distinction between innovation creation and innovation adoption is another issue that is argued by many scholars. Since the innovation creation and innovation adoption have different contexts in terms of their purposes, implementation strategies, skills, and resources (Kamal et al. 2015), distinguishing innovation creation from innovation adoption is appropriate (Yusof et al. 2014). Damanpour and Wischnevsky (2006) proposed that companies that create innovation use their technical and market skills, while innovation-adopting companies generally use managerial capabilities. Because, in innovation creation, a final product should be completely new to the market, whereas the improved product is introduced in innovation adoption (Song & Montaya-Weiss, as cited in Kamal et al. 2015). In other words, the major difference between innovation creation and innovation adoption is the level of newness (Song & Montaya-Weiss, as cited in Yusof et al. 2014). Therefore, innovation adoption is expected to become more familiar in the market, while innovation creation is more uncertain and unknown (Ravichandran, 2000). Arguably, there may be a qualitative difference between "innovation" and "imitation" or "innovation creation" and "innovation adoption," but in this study, all were regarded as innovative.

2.2. Classification of Innovation

Schumpeter's work profoundly influences most of the innovation classifications in the literature. According to his classification, innovations can be examined under five types: the introduction of new product or new quality product, the introduction of new method of production, opening a new market that has not previously entered, conquest of the new supply source and practicing the new organization of industry (Schumpeter, 1934, p. 70). Similarly, in the Oslo Manual, innovation is categorized into four types, which are the product, process, organizational, and market innovations (OECD, 2005). The description and examples of each type of innovation are provided in Table 2.1. It is also worth to note that, product and process innovations are regarded as a technical innovation and organizational and market innovations are regarded as an organizational innovation in the manual (Anderson & Manseau, as cited in Blayse & Manley, 2004).

Table 2.1. *Innovation Types and Examples*

Type of innovation	Definition	Examples
Product Innovation	New or significantly improved good or service introduction in terms of its characteristics or intended use.	Improvements in technical specifications, change in material, improved user-friendliness, changes or enhancements in used software, improvements in functionality, etc.
Process Innovation	New or significantly improved production or delivery method implementation. Decreasing unit cost of production or delivery or increase in quality are aimed at process innovations.	Improvements in equipment or software, change in production method, advancements in communication methods and technology, etc.
Organizational Innovation	New organizational method implementation in the firm's business practices, work environment or inter-organizational relations.	Improved knowledge sharing methods, improvements in management systems, improved labor productivity, new channels for accessing information, etc.
Marketing Innovation	New marketing method implementation that involves significant changes in product design or packaging, product placement, promotion methods or pricing.	Using a new pricing strategy, entering a new market, a new position for a product in the market, changes in the packaging of the product, etc.

Any type of innovations explained above may stimulate another type. For example, according to the study of Gambatese and Hallowell (2011), the product-process pattern is widespread in the industry, because product innovations generally require new production methods. Also, the adoption rate of innovation highly depends on the type of innovation. For instance, many researchers in the literature have observed that product innovations are realized at a greater rate when compared to the process innovations (Gambatese & Hallowell, 2011).

Another classification can be made in the degree of innovation. According to Tushman and Nadler (1986), each type of innovation can be gradated in three degrees; incremental, synthetic, and discontinuous. Incremental innovations provide customers a product with extensions, new versions or additional features, higher quality or lower

cost, while synthetic innovations result in the significantly improved product as a result of the creative combinations of existing resources (Tushman & Nadler, 1986). In discontinuous innovations, however, a completely new idea or technology is the case (Tushman & Nadler, 1986).

2.3. Innovation as a Source of Competitive Advantage

In today's world, globalization and complexity of the client requirements are continuously increasing which result in the occurrence of much more competitive environment in the various markets (Seaden et al. 2003). Innovation is necessary for companies even to continue their existence in today's highly competitive environment (Kline & Rosenberg, 1986). In order to enter new markets, to be more active in the existing market, to increase the profitability or to gain competitive advantage, being innovative is vital for companies (Seaden et al. 2003; Gunday et al. 2011). For example, when the innovator and non-innovator companies are compared, it is revealed that innovators are more successful and achieve higher growth and greater market share than the non-innovators (Tidd & Bessant, 2009). According to the Australian government, companies will definitely get in return for their innovations in the long-term and their innovative solutions for emerging problems will ensure their competitiveness in the market (Tidd & Bessant, 2009). In the study of Seaden et al. (2003), the companies who participated in the study have seen innovation as a requirement at least for maintaining their current positions in the market. But, the majority of them are aware of the fact that innovation is an essential source for gaining a competitive advantage over the rivals (Seaden et al. 2003). Innovation enables companies to improve their positions in the market (Seaden et al. as cited in Martínez-Román et al. 2017). In terms of competitive positioning, companies may take either a reactive or proactive approach (OECD, 2005). In a proactive approach, companies innovate to maintain their strategic position in the market; on the other hand, in a reactive approach, they gain a competitive advantage over their rival by innovating (OECD, 2005).

One of the possible outcomes that push companies to innovate is the reduction in production costs through innovation (Slaughter, 1998). With the emergent technologies and their implementations into production processes, production costs have reduced as a result of a decrease in the required manpower and production flaws. Also, some innovations, particularly radical ones, result in the emergence of new markets (Slaughter, 1998). In addition to the economic benefits namely increase in productivity, reduction in production costs or growth in market share, intangible benefits can also be gained through innovation (Slaughter, 1998). Generally, intangible benefits like achieving a stronger competitive position, gaining experience or improving reputation are more important than the economic benefits (Ramcharan, as cited in Slaughter, 1998). Because, according to Schumpeter, the competitive advantage that is created by technological innovations is temporary and can be imitated by the rivals in a relatively short time (Frenkel et al. 2015).

Size of the company plays an important role in shaping innovation activities. Most of the time small companies are concentrated on daily operations, while larger companies are involved in more advanced practices (Seaden et al. 2003). Because the primary reason for small companies to innovate is to survive and to solve the urgent daily problems, while large companies aim to grow by innovating (Loosemore, 2015). Loosemore (2015) explains the reason behind this tendency as the limited slack sources and low technology usage of small companies compared to large ones. Similarly, the size factor should be considered when the effect of innovation over the companies are discussed as well. Because many studies in the literature have shown that different types and degree of innovations have different impacts on companies with different sizes. For example, while the innovation in the business practices provides a competitive advantage and stronger position in the market to the large firms, it actually causes extra cost and lower profit to the small size firms (Seaden et al. 2003). Therefore, due to their more risk-averse nature, generally, small firms tend to consider innovation as an additional risk to their businesses, especially in the environments where the threats due to the rivalry are intense (Seaden et al. 2003).

The geographic market (local, regional, national or international) where the companies carry out their activities is very impactful on innovative behavior. Internationalization and innovation are directly related to each other (Martínez-Román et al. 2017). In the international arena, companies tend to be more active in innovating (Barata & Fontainha, 2017), because of the highly competitive environment. In other words, to compete internationally, companies are forced to improve their products and efficiencies (OECD, 2005).

Yusof et al. (2014) warn companies whose innovation activities are based mostly on imitating the others, about the risks of their strategies. Because, although innovation adoption provides a relatively faster solution, after a certain point competing with more advanced rivals will be inevitable (Kambel et al. as cited in Yusof et al. 2014; Bygballe & Ingemansson, 2014). Therefore, creating a robust innovation strategy and managing the innovation process properly is essential to ensure continuous improvement and a strong competitive position.

2.4. Management of Innovation

The innovation process is complex and dubious, and surprises are inevitable (Van de Ven et al., 1986), therefore the success of innovation cannot be guaranteed. The success of innovation and thus, the performance and competitive advantage of companies depend significantly on the management of innovation (Kulatunga et al. 2006). Therefore, companies should follow proper innovation strategies and innovation management practices.

Innovation process depends highly on the sectoral characteristics as well as the company's organizational characteristics (OECD, 2005). Therefore, the degree, rate, and type of innovations differ depending on the sector that companies act. For example, in high-tech industries, R&D activities are intensively carried out, and generally, more radical and faster innovations are realized. On the other hand, in industries that are more traditional, generally incremental innovations occur based on the available technology and knowledge (OECD, 2005). So, these differences should

be considered, when deciding on the management strategy and in innovation assessment as well.

Type of innovation and the objective of the company are highly relevant to each other (OECD, 2005). For instance, the demand side generally drives product and market innovations, while process and organization innovations are driven by the supply side (OECD, 2005).

To achieve successful innovation management, companies should use their both managerial and physical capabilities (Bygballe & Ingemansson, 2014). Because the success in innovation can be reached when both the organizational characteristics and strategies are compatible with the innovation process (Dikmen et al. 2005).

In the literature, different innovation process models are available. Schroeder et al. (1986) have investigated some of these models in their work. Some of the innovation process models are summarized in Table 2.2.

Table 2.2. *Innovation Process Models*

MODELS					
Schumpeter's innovation process model (1934)	Invention	Innovation	Diffusion	Imitation	
Usher's normative model of innovation (1954)	Perception of problem	Setting the stage	Act of insight	Critical revision	
Roger's innovation model (1986)	Need	Research	Development	Commercialization	Diffusion
Slaughter's innovation model (2000)	Identification	Evaluation	Commitment	Use and post-use evaluation	
Tangkar and Arditi's innovation model (2000)	Need	Creation	Invention	Innovation	Diffusion
Boer and During's innovation model (2001)	Goal setting	Design and organization of the innovation process	Monitoring the progress	Adjustment of the process	
Sexton and Barrett's cyclical innovation process model (2003a)	Diagnosis	Action plan	Taking action	Evaluation	Specific learning

Although the phases of each model are named differently, all innovation process models actually start with the determination of the need and the goal setting. Therefore, at the beginning of the process demand conditions and the company's own capacity should be assessed carefully for an effective innovation (Tushman & Nadler, 1986).

According to Schumpeter, companies can achieve economic growth, not by the realization but the diffusion of innovation (Śledzik, 2013). Also in their works, Sexton and Barrett (2003a) emphasize the requirement of successful implementation for successful innovation. In Oslo Manual (OECD, 2005), implementation of innovation is defined as the actual use of innovation in the company's operations. But, most of the time the organizational adaptation and diffusion steps are ignored or underestimated by companies (Boer & During, 2001) which causes the disappearance of innovation. To ensure the success of innovation, effective coordination and cooperation within the company should be provided. There may be different methods to diffuse the innovation within the firm and among companies. Arranging training for the employers, personnel transfer and organizing seminars are among the possible activities to diffuse the innovations. A good example of innovation diffusion practice can be given from one of the largest French contractors that were investigated in the study of Miozzo and Dewick (2002). In order to enable the diffusion of new ideas and knowledge among the employees, the company has developed a network within the company and organized activities.

Sometimes new ideas arise coincidentally or independently of any of these steps. In order to turn these ideas into innovation, the process should be appropriately managed, and the implementation and diffusion of innovations should be ensured (Bygballe & Ingemansson, 2014).

The degree, type, and orientation of the innovation are associated with the characteristics of the company (Kamal et al. 2015). Seaden et al. (2003) have added the size of the firm and the operating market to their proposed innovation analysis

model as factors that affect the innovation activities of companies. The result of their study has shown that the innovativeness is directly proportional with the size of the companies, and larger companies are three times more active in using innovative approaches than the smaller companies (Seaden et al. 2003). This is generally because of the limited financial resources and technical capabilities of the smaller companies (Damanpour as cited in Barata & Fontainha, 2017). However, it is also discussed that the flexible organizational structure of smaller firms and closer relationships with customers make them more responsive to the demands and changes and facilitate innovation in small companies (Gamal et al. 2011). The model of Seaden et al. (2003) and the study of Kulatunga et al. (2006) are consistent with the Sexton and Barrett's study (2003b). In their work, they concluded that in addition to the size of the company, the type and the degree of innovation activities depend highly on the environment that the company operates.

Changing the environment and competitive conditions may cause the failure of a company that has achieved successful innovation previously, although the factors are the same as before (Tushman & Nadler, 1986). Therefore, companies should follow dynamic innovation management strategies. They should avoid stagnation in their innovation activities, but at the same time, they should implement the new applications to utilize them (Bygballe & Ingemansson, 2014). In other words, while improving and stabilizing their current works, companies should also prepare themselves for future works by considering the present conditions and learning from their experiences (Tushman & Nadler, 1986) because innovativeness can only be achieved, as a result of the continuous and active development process (Sexton & Barrett, 2003b). Information generation is critical for maintaining this dynamism. In addition to internal knowledge generation, information flow from external sources is crucial for developing innovations regardless of the size of the company (Barata & Fontainha, 2017). Characteristics of the links with these resources have great importance because these links provide information about the reaction of companies to their business environments (OECD, 2005). In other words, providing this information flow and

accessing the knowledge substantially relate to the type and degree of relationship between the organizations and the company (OECD, 2005). For example, companies who are operating in a more volatile environment need to develop more links with many different organizations to reach knowledge and technology. Universities, clients, institutions, suppliers and other companies are among the possible external information sources. In Oslo Manual, linkages are examined in three types, which are open information resources, acquisition of knowledge and technology and innovation co-operation (OECD, 2005). Open information resources are openly available for everyone and do not require any purchasing or direct interaction with sources. In the second type, knowledge is accessed through the purchasing of external knowledge or technology without requiring direct interaction with the sources. In innovation co-operation, companies interact with one or more external information resources to reach or purchase the information (OECD, 2005). In brief, deciding on how to obtain and use knowledge, in other words managing the knowledge has an important place in innovation management (Dikmen et al. 2005).

Information transfer is another crucial step in the new idea generation and innovation diffusion as well. For example, in the industries where the projects are carried out by the contribution of many participants like the construction industry, to achieve successful implementation of the innovation, knowledge should be transferred among the project participants (Ozorhon, 2017). Because, innovation is a product of collaborative work and it should be adopted by all the participants (Håkansson, as cited in Bygballe & Ingemansson, 2014; Loosemore, 2015). Therefore, both in the realization and diffusion phases of the innovation, conformity of participants, sharing resources and knowledge, and commitment to the common goals are required for the success (Gambatese & Hallowell, 2011).

2.5. Innovation Assessment

2.5.1. The Need for Assessment of Innovation Performance

Investigating the innovation performance and the factors that affect it draws great interest. However, since the field is relatively new, there is no generally accepted assessment framework or metrics in use. Therefore, coming to a conclusion with reference to the available data and statistics is not possible (Seaden et al. 2003).

As in every activity in the industry, that requires an investment of money and time, the performance of companies in innovation activities should be assessed due to several reasons. Improving the understanding of the growth of companies is the primary goal of the innovation performance assessment (IPA) (Rose et al. 2009). In other words, in order to make a comparison between past performances and current situation and to understand the course of events in the company's business, assessment is required (Gamal et al. 2011). So that, as a result of the assessment, strengths and weaknesses in different areas can be revealed. Therefore, the company can know where to focus their attention on for utilizing the innovation at the maximum level (Gamal et al. 2011) or in case of a negative situation; it may have a chance to interfere before the company is affected. Also as Morris (2008) stated, innovation process assessment is both a part of the learning improvement process and learning itself. Briefly, in order to be able to manage the innovation process, innovation assessment is required (Morris, 2008).

Companies will have hard data that reveals the effects of the innovative activities on their business by assessing innovation. When they have something tangible rather than verbal statements, the importance of innovation can be understood better by both the employees and the top management (Gamal et al. 2011). Thus, the commitment and support to the innovation activities increase.

However, the survey that was conducted by The Boston Consulting Group (BCG) revealed that companies have difficulty in assessing innovation because they do not know what to assess, how to collect related data and how to analyse and use this data

in the decision process (Andrew et al. 2009). According to the study of Andrew et al. (2009), companies are not aware of the benefits of innovation assessment, and for this reason, most of the companies are concerned about if it is worth to spend time for assessment activities. Therefore, most of the companies do not assess the innovation, and some of them among others make assessments incorrectly, which cause companies to take a decision presumptively or inaccurately (Andrew et al. 2009).

Assessing innovation performance correctly is beneficial for companies in many ways. To determine the performance, assessing innovation activities is very important. More importantly, performance assessment is required for further improvement. Through the IPA, companies may identify the types of innovation and innovation activities that company works on, enablers and barriers to innovation and the methods that company follows during and after the innovation process (OECD, 2005).

2.5.2. Innovation Assessment Indicators

The innovation process is complex and reducing this process into measurable elements is not easy (Gamal et al. 2011). Different metrics that were used in the innovation assessment are available in the literature. For example, in the past works of many scholars, the total number of new products and new properties or functions added to products were used in the assessment of innovation (Toole as cited in Seaden et al. 2003; Slaughter, 1993). However, in most of the cases, even if the production method or the process is new or significantly improved, generally the final product is not different before. In such situations, traditional innovation indicators like the number of new products or the sale percentage of these products may not reflect the innovation performance correctly (Seaden et al. 2003). As Sutton (as cited in Loosemore, 2015) discussed, innovative firms generally tend to use a broader range of innovation metrics in evaluating their innovation performance. Therefore, broadening the range of metrics is required to reflect the real performance. Seaden et al. (2003) supported this approach and suggested that the rate of growth, changes in market share and repeat orders are among the possible innovation assessment indicators, in addition to

traditional indicators such as number of new products (Toole as cited in Seaden et al. 2003), sales percentage of these products or R&D related indicators. According to Ozorhon and Oral (2017), the reasons that underlie the decisions of companies to innovate should also be included in the IPA process.

In the last half-century, with the rapid development of the technology R&D studies have accelerated and had a dominant role in the innovation literature. Therefore, there is a tendency to assess the innovation level with R&D related indicators like R&D expenditures, number of patents, number of R&D personnel, etc. However, in the literature, it is frequently argued that whether measuring the level of R&D related investments alone is an appropriate way to assess the innovation performance of companies or not. In spite of the fact that the R&D related indicators constitute a significant part of the IPA, as OECD (as cited in Kulatunga et al. 2006) has reported in 1996, innovation may arise from many different sources. As stated in the Frascati Manual, R&D is only one of the steps in the continuous innovation activities (OECD, 2005). Therefore, the innovation activities are classified as R&D activities and non-R&D activities in the innovation surveys of OECD (Barata & Fontainha, 2017). The difference between R&D and non-R&D is explained in OSLO Manual as "*the presence in R&D of an appreciable element of novelty and the resolution of scientific and technological uncertainty*" (OECD, 2005). However, generally distinguishing R&D and non-R&D activities are still confusing for companies (OECD, 2005). For example, cooperation with research institutions, training employee or hiring skilled employees, using consultants and investing in innovative equipment are among the non-R&D innovation activities (OECD, 2005).

Rothwell (as cited in Hao et al. 2017) identified 5 different generations of innovation models and emphasized that innovation assessment approaches are evolved in time with the emerging characteristics of different generations. In the first and the second generations (throughout the 1950s and 1960s), R&D expenses, number of R&D personnel and the education level of this personnel, i.e., inputs, were used in the innovation assessment (Hao et al. 2017). In the third and fourth generations

(throughout the 1970s and 1980s), assessment practices became more complex with the inclusion of intermediate inputs such as an increase in quality, publications, and patents (Hao et al. 2017). In the fifth generation (last two decades), the complexity of the innovation process has been comprehended better and intangible innovation inputs, and outputs have included in the assessment process (Hao et al. 2017). However, as Hao et al. (2017) highlighted in their study, the available metrics actually are not enough to assess the complicated innovation process.

In the BCG Senior Management Survey, it is revealed that most of the companies use a limited number of metrics in their innovation assessment practices; however, it is suggested that they should use as many metrics as possible in the IPA practices (Andrew et al. 2009).

In the IPA, financial data is frequently used (Hao et al. 2017). Increase in return, change in market share, percent sales from new products and return on investment in the new product are some of the financial indicators (Hao et al. 2017). However, most of the time reaching this data is challenging. Because, information about the innovation expenditures generally is not separately specified in the companies' account which makes assessment more difficult (OECD, 2005). Also, since innovation is a continuous process, the results of the innovations may not be clearly observed during the evaluation period (OECD, 2005). Return on investment (ROI) is one of the most preferred assessment metrics by the managers (Morris, 2008). However, according to Morris (2008), most of the time ROI is not assessed in the right time, which is the end of the innovation process cycle, and results in the unrealistic, optimistic predictions of revenue. In other words, ROI-based assessments prompt companies to assess short-term performance (Morris, 2008) which is undesired in the effective performance assessment.

2.5.3. Innovation Assessment Frameworks

2.5.3.1. Innovation Dynamo

Innovation Dynamo is a part of the innovation policy terrain proposed by OECD in 1997 Oslo Manual. In the manual, the structure of Innovation Dynamo is described as the complex system that includes the factors shaping the company's innovation activities at the firm level (OECD/Eurostat, 1997). It constitutes the core of the framework and covers internal and immediately external factors that affect the company's innovativeness (OECD/Eurostat, 1997). The subject approach, which investigates the innovations and influencing factors as a whole, is used in Innovation Dynamo. Therefore, understanding the innovation generation mechanism within the company and the characteristics of the company that affects innovation performance are crucial in this perspective. Within this framework, Innovation Dynamo enables to assess companies' technological innovation performances in terms of strategic, R&D and non-R&D activities (OECD/Eurostat, 1997). In Table 2.3, innovation activity types covered in Innovation Dynamo are explained.

Table 2.3. *Innovation Activity Types Included in Innovation Dynamo (adapted from OECD, 1997)*

Activity Types	Description
Strategic	Activities related to the creation of the conditions and environment where the innovation will constitute the strategic type of innovation activities. Investigating the conditions of the market where the intended innovation will be realized is an example of this type of innovation activities.
R&D	R&D related activities as explained in Frascati Manual are included in this type. Carrying out researches and experiments to improve the production process, designing prototype, testing it and further research for improvements for introducing a new type of products are among the R&D related innovation activities.
Non-R&D	Non-R&D innovation activities are the activities that contribute to innovation performance but do not have any direct relationship with R&D. Buying technical information or patented inventions, buying expertise or using consultants and quality improvements are some examples of non-R&D activities.

As stated in the Oslo Manual Innovation Dynamo is designed for use in the assessment of technological innovations, i.e., organizational innovations are excluded (OECD/Eurostat, 1997). Therefore, although it enables detailed investigations in technological innovations, its usability is limited especially in non-tech industries.

2.5.3.2. Innovation Radar

Innovation Radar (IR) was originally developed by the researchers Mohanbir Sawhney, Robert Wolcott and Inigo Arroniz in 2006. According to Sawhney et al. (2006), the problem in companies' innovation approach is that they generally consider innovation the same as developing a new product or carrying out R&D studies. This leads to the same innovation activities in the market and innovations that respond to the needs of the same customer group. This narrow view on innovation causes companies to miss market opportunities; for this reason, they should broaden their innovation views (Sawhney et al. 2006). Sawhney et al. (2006) have suggested that instead of one-dimensional innovation, companies should focus on business innovation that is defined as "the creation of substantial new value for customers and the firm by creatively changing one or more dimensions of the business system." Through the literature review and interviews with authorities, Sawhney et al. (2006) have determined 12 dimensions for business innovation and visualized as radar, as shown in Figure 2.1. 4 of 12 dimensions which are offerings, customers, processes and presence are the major dimensions. The definitions and examples for 12 dimensions are presented in Table 2.4.

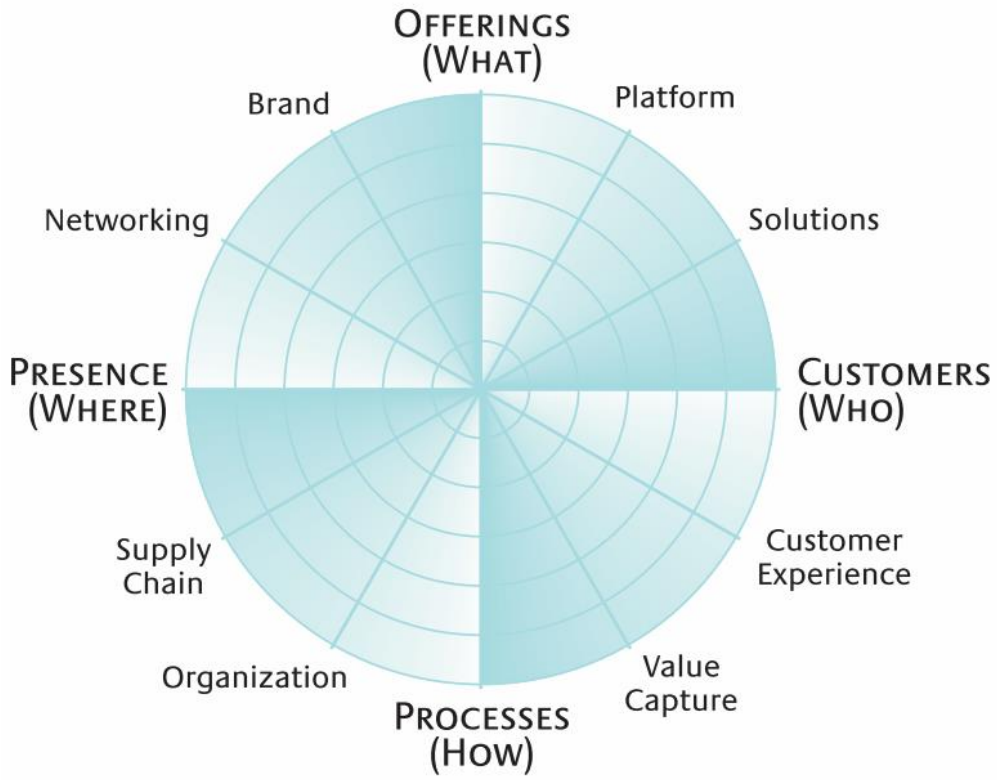

Figure 2.1. Innovation Radar (Sawhney et al. 2007)

Table 2.4. *12 Dimensions of Business Innovation (adapted from Sawhney et al. 2006)*

Dimension	Explanation
Offerings	Innovating in this dimension involves the creation of new products, goods or services that the customers are willing to pay for. Examples for this dimension are Apple iPod music player and Gillette Mach3Turbo razor.
Platform	Platforms can be defined as a set of common components or production steps of the company's product or service portfolio. For example, Nissan has produced an engine block and used it in its different car models.
Solutions	Solution innovation is creating integrated and customized solutions to customer problems. For example, DuPont Building Innovations discovers and develops innovative products and integrated systems for construction companies to compete in the market.
Customers	Innovation along this dimension requires discovering a new customer group or revealing the needs of customers that have never been met before. A good example for the customer dimension is that Virgin Mobile USA offered cellular service for the young customers and attracted millions of customers.
Customer experience	Customer experience dimension covers all the experiences when the customers interact with the company. As an example for the customer experience dimension, the health care provider Kaiser Permanente has provided their customers comfortable waiting room, privatized exam rooms, and clearer directions and provide their customers with better experiences.
Value capture	Innovation in value capture dimension is the new way of the company's payment receiving and income stream. Google paid search can be given as an example of value capture dimension.
Processes	Process innovations cover the redesigning of business activities to obtain higher quality, greater efficiency or shorter cycle time. Toyota Production System is one of the best examples of process innovations.
Organization	Innovation in the organization of the company is about changing or improving the definition of the role and responsibilities of employees and the structure of the company. Procter & Gamble's front-back hybrid organization for customer focus is an example of organization innovation.
Supply chain	In supply chain innovation, companies may change the structure of the chain, regulate the information flow through the supply chain or improve the relations between the participants of the supply chain. The example of Moen ProjectNet who collaborates with suppliers for design can be given for this dimension.
Presence	This dimension involves the innovations in the market where the company carries out its activities and in the distribution channels of the company. The entrance of Titan Industries with wristwatches in the Indian market is a good example of the innovation along presence dimension.
Networking	Improvements or changes in networks of the company that connect the company's products and customers are in the scope of this dimension. For example, integrated network with GPS in the trucks provides better delivery of ready-to-pour concrete and lower operating cost to CEMEX.
Brand	In order to innovate along this dimension, companies should improve and widen their brands and images. The easyGroup is one of the best examples for this dimension. By extending their activity areas and services, they have reached many people with the name of "easy" like easyJet, easyMoney and easyHotel, etc.

To assess the performance in each dimension, they have proposed two types of metrics; the first one is reflective metrics and used to assess the actual level of innovativeness and the second one is formative measures which can be used to understand innovation activities, and the factors affected the process (Sawhney et al. 2006). The most significant advantage of IR is that it enables companies to visualize their innovation performances. Visualization is useful for both having hard data and comparing the current situation with past performances and stated strategies. Additionally, when the companies analyze the market by using IR, they may identify neglected dimensions by their rivals and may have a chance to turn this into an opportunity for themselves (Sawhney et al. 2006).

2.5.3.3. Innovation Value Chain

According to the perspective of Hansen and Birkinshaw (2007), all companies face different challenges in their businesses, although they are operating in the same industry. For this reason, there is no single ideal way to overcome various challenges. From this point of view, they recommended companies first to understand their current innovation processes, then determine the challenges they are faced and develop methods to overcome these particular challenges, instead of directly adopting the trendy innovations (Hansen and Birkinshaw, 2007). Therefore, they have presented innovation as a sequential process and developed the Innovation Value Chain (IVC) that is composed of three main phases, which are idea generation, idea conversion, and idea diffusion. In the first phase, as its name implies ideas are generated through departmental, interdepartmental or external knowledge share. In the idea conversion phase, ideas that fit the companies' objectives best are selected, funded and developed. In this stage, investing the right ideas is important, because the increase in profit or productivity is the ultimate expectations (Hansen & Birkinshaw, 2007). The last phase is the diffusion phase where the innovations spread within the company and the external environment. While assessing the innovation performance companies should evaluate themselves according to six sub-stages by answering some key questions.

Hansen and Birkinshaw (2007) proposed these fundamental questions and key performance indicators (KPI) for each phase as presented in Figure 2.2.

	IDEA GENERATION			CONVERSION		DIFFUSION
	IN-HOUSE Creation within a unit	CROSS-POLLINATION Collaboration across units	EXTERNAL Collaboration with parties outside the firm	SELECTION Screening and initial funding	DEVELOPMENT Movement from idea to first result	SPREAD Dissemination across the organization
KEY QUESTIONS	Do people in our unit create good ideas on their own?	Do we create good ideas by working across the company?	Do we source enough good ideas from outside the firm?	Are we good at screening and funding new ideas?	Are we good at turning ideas into viable products, businesses, and best practices?	Are we good at diffusing developed ideas across the company?
KEY PERFORMANCE INDICATORS	Number of high-quality ideas generated within a unit.	Number of high-quality ideas generated across units.	Number of high-quality ideas generated from outside the firm.	Percentage of all ideas generated that end up being selected and funded.	Percentage of funded ideas that lead to revenues; number of months to first sale.	Percentage of penetration in desired markets, channels, customer groups; number of months to full diffusion.

Figure 2.2. Innovation Value Chain (Hansen & Birkinshaw, 2007)

In their study, Hansen and Birkinshaw presented a sample questionnaire, which is shown in Figure 2.3. According to the average answers, the weakest innovation-related activities, which have the highest score in the questionnaire, are determined. In the IVC, the aim is to determine the weakest links and to make companies focus on their weaknesses. Because, according to Hansen and Birkinshaw (2007), the weak links are the indicators of the innovation performance of companies and they should work to improve their weak links.

	Do not agree	Partially agree	Agree	Activity	Phase
Our culture makes it hard for people to put forward novel ideas.	1	2	3	In-house idea generation	High scores indicate that your company may be an **idea-poor company**.
People in our unit come up with very few good ideas on their own.	1	2	3		
Few of our innovation projects involve team members from different units or subsidiaries.	1	2	3	Cross-pollination among businesses	
Our people typically don't collaborate on projects across units, businesses, or subsidiaries.	1	2	3		
Few good ideas for new products and businesses come from outside the company.	1	2	3	External sourcing of ideas	
Our people often exhibit a "not invented here" attitude—ideas from outside aren't considered as valuable as those invented within.	1	2	3		
We have tough rules for investment in new projects—it's often too hard to get ideas funded.	1	2	3	Selection	High scores indicate that your company may be a **conversion-poor company.**
We have a risk-averse attitude toward investing in novel ideas.	1	2	3		
New-product-development projects often don't finish on time.	1	2	3	Development	
Managers have a hard time getting traction developing new businesses.	1	2	3		
We're slow to roll out new products and businesses.	1	2	3	Diffusion	High scores indicate that your company may be a **diffusion-poor company**.
Competitors quickly copy our product introductions and often make pre-emptive launches in other countries.	1	2	3		
We don't penetrate all possible channels, customer groups, and regions with new products and services.	1	2	3		

Figure 2.3. Sample Questionnaire for IVC (Hansen & Birkinshaw, 2007)

2.5.3.4. Innovation Funnel

Morris (2008) has visualized the innovation processes as a funnel that composes of 9 stages and emphasizes that the performance assessment should be done in each phase. According to his perspective, at the beginning of the innovation process, many ideas are created, but only some of them arise as a value in consequence of the activities performed in the different stages inside the funnel.

The model can be divided into three phases according to the content of the stages as shown in Figure 2.4. The scope and structure of innovation are determined in the stages -1 and 0 (input). In stage -1, innovation strategies are developed based on the needs of the company and the market conditions. In other words, the aims and needs are determined in this stage. In stage 0, it is suggested that the success of innovation projects should be evaluated as a portfolio and the innovation decisions should be made not based on the individual projects but the project portfolio (Morris, 2008). Stages 1 to 6 constitutes the second phase, which is the innovation process itself. In stage 1, the needs and opportunities in the market that have never discovered before are revealed through in-depth research. Then, in the light of the results of the research stage ideas are created in stage 2, which is named as ideation. Stage 3 is a convergence point where the actionable insight about innovation opportunities are created through the transformation of ideas created in the previous stage (Morris, 2008). In the light of the outputs from the previous stages, the type of the innovation (or target) is decided in stage 4. The outputs of stage 3 are combined to develop a set of ideas further, and all of the ideas under development in this stage actually constitute the portfolio in stage 0 (Morris, 2008). In the last stage of the innovation process, ideas are converted into complete innovations and all the engineering practices, tests and prototyping are realized in this stage (Morris, 2008). At the end of the innovation development stage, innovations become ready for marketing and the last phase of the model where the innovations earn economic value starts. Stage 6 and 7 are the phases where the marketing and selling activities realize. These stages are the outputs of the whole innovation process and the ultimate aim of the innovation, which is gaining profit or increasing the market share or both, is reached.

Figure 2.4. Innovation Funnel (Morris, 2008)

In the innovation funnel, assessment is done through previously determined qualitative (soft) metrics and quantitative (hard) metrics (Gamal et al. 2011). The reason behind it is forcing assessors to broaden their innovation viewpoints (Morris, 2008). A list of example metrics for each stage is provided in the study of Morris. However, these metrics should be thought of as a starting point, and companies should work on the metrics according to their business. It is also worth to note that according to Hao et al. (2017), Innovation Funnel is not sufficient to assess the complicated innovation process.

2.5.3.5. Innovation Audit

Innovation Audit was developed by Joseph Tidd, John Bessant and Keith Pavitt in 2009. They have mentioned the Innovation Audit and the ways to use it in their book "Managing Innovation" (2009). Innovation Audit assesses the innovation performance of the company along 5 dimensions which are the strategy, learning,

linkages, process, and innovative organization (see Figure 2.5). Strategy dimension covers the strategic planning process, prioritization and implementation of the innovation strategy (Hao et al. 2017). In process dimension properties of the production process are investigated (Gamal et al. 2011). Internal process management practices are also evaluated in this dimension. The organizational structure and organization's approach towards innovation is considered under the organization dimension. The communication and co-operative relations within the company also included in this dimension (Gamal et al. 2011). In linkages dimension, the external relationships and information flow through these links are evaluated. Lastly, in the learning dimension training of employees, company's ability to gather information from linkage and to learn from experiences, and company's ability to diffuse these learnings within the firm are assessed (Gamal et al. 2011). In their book, Tidd et al. (2009) have provided a list of statements for assessing the companies' innovation performance along each dimension by using Innovation Audit.

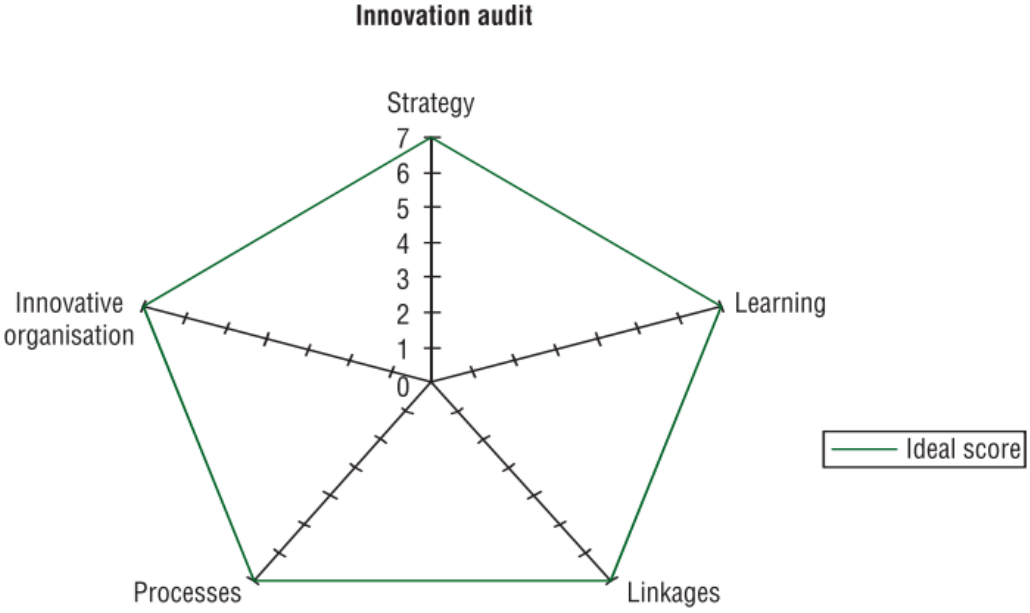

Figure 2.5. Innovation Audit (Tidd et al. 2009)

2.5.3.6. The Model of "Ten Types of Innovation"

The starting point of "Ten Types of Innovation Model" is the study of Keeley et al. (2013) to investigate the common properties of successful innovations and to create a kind of periodic table that consists of the innovation elements. According to their approach, successful innovators innovate in many different areas (Keeley et al. 2013). In other words, as opposed to the idea of the linear innovation model, more than one innovation can be realized at the same time (Hao et al. 2017). According to their focuses, ten types of innovation are classified under 3 categories as shown in Figure 2.6. The innovation focus goes from the company's internal activities to customer-oriented activities, from the rightmost innovation type to leftmost innovation type (Keeley et al. 2013). The explanation of innovation types is provided in Table 2.5.

Figure 2.6. Ten Types of Innovation (Keeley et al. 2013)

Table 2.5. *Explanations of Ten Types of Innovation (adapted from Keeley et al. 2013)*

	Innovation Types	Explanation
Configuration	**Profit model**	In profit model innovation, companies find a new way to convert their created values into the cash. New pricing methods and premium prices are included in this type of innovation. Hilti's Tool Fleet Management practice and Gillette's pricing strategy can be given as an example of profit model innovations.
	Network	Network innovations are including activities like collaborations with other companies for making use of other companies' advantages, ventures for risk sharing, franchising, and secondary market creation. The partnership of UPS and Toshiba is one of the examples of network innovations.
	Structure	Structure innovations are related to the assets organization, management systems, and corporate systems. "Community Owned Company" model that was introduced by Indian retailer Fabindia can be an example for structure innovations.
	Process	Process innovations are included the significant changes in the production systems to produce the goods or products offered by the company. Lean Production system introduced by Toyota is one of the best examples of process innovations.
Offering	**Product performance**	The changes or improvements in the quality and properties of the companies' offerings are evaluated under product performance innovations. For example, the vacuum produced by Dyson that has a transparent and bag free design made Dyson best-selling in the UK.
	Product system	Product system innovations are the innovations in connections or bundling techniques between different products or services to create disparate valuable offerings. One of the best examples for product system innovations is the MS Office programs that were offered as separate products before, but today offered as a bundle product.
Experience	**Service**	Service innovations improve the utility and the performance of the company's offerings, make them easy to use and fix the problems of offerings. In the economic recession period, Hyundai's assurance program that allows people who buy Hyundai and lose their job in the first year of ownership to walk away from the car and its payment.
	Channel	Channel innovations are the changes in the ways that connect the company's offerings to customers. For example, Nike presents its products to customers through NIKETOWN stores with their sportive ambiances and professional employees from different sports branches.
	Brand	Brand innovations help companies to be realized and preferred by customers over their rivals. For example, Intel is the most preferred processor with its brand value and "Intel Inside" slogans on the computers.
	Customer engagement	Customer engagement is about forming a meaningful connection between the demand of the customers and the company. For example, in Foursquare "Mayorship" of a place that is gained by the user who visits that place the most leads to competition between users.

The model can be used for investigating both the innovation practices of the company and the environment in which the company competes. Assessment is done according to the answers given the key questions provided in the study of Keeley et al. (2013). After assessing the innovation performance for ten types of innovation, an innovation profile (see Figure 2.7) is obtained, and the weaknesses of the company in different innovation types are revealed.

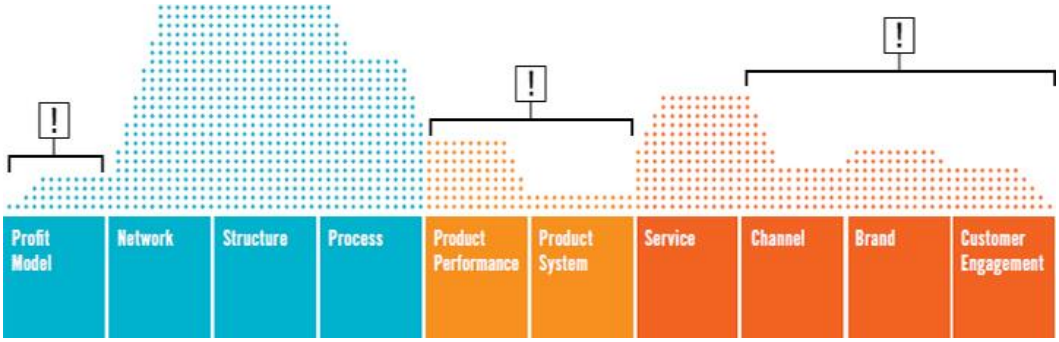

Figure 2.7. Example Profile: Innovation Types that Require Attention (Keeley et al. 2013)

2.5.3.7. The Model of Dulkeith and Schepurek

In their study, Eric Dulkeith and Steven Schepurek (2013) emphasize the importance of IPA in the management of innovation process by citing the following statement from Peter F. Ducker "What gets measured gets managed." In this regard, they proposed an innovation assessment model with six dimensions that cover the whole innovation process (see Figure 2.8). The model enables to assess the innovation process in terms of the inputs, the process itself and the outputs, which allows real-time assessment since the effects of innovation activities in different phases of innovation cannot be observed at the same time (Dulkeith & Schepurek, 2013).

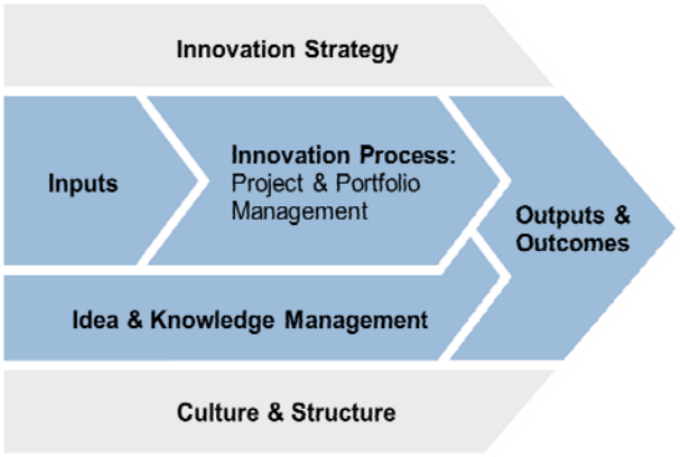

Figure 2.8. The Model of Dulkeith and Schepurek (2013)

According to their perspective, innovation assessment ultimately increases innovation performance (Dulkeith & Schepurek, 2013). Therefore, they advocate using the metrics in innovation assessment such that they both assess and drive the innovation. In the innovation assessment with this model, different types of metrics are used. While some of the KPIs like percentage of sales of new products can be expressed by numbers from the companies' records, the others require an in-depth investigation and conceptual background. Possible KPIs provided in the study of Dulkeith and Schepurek are presented in Table 2.6. However, as stated in the study, companies consider most of the measures introduced in Table 2.6 impractical for industry use especially for the large projects (Dulkeith & Schepurek, 2013).

Table 2.6. *KPIs for Six Dimensions (adapted from Dulkeith and Schepurek, 2013)*

Dimensions	Key Performance Indicators
Inputs	• Innovative work behavior (IWB) • R&D intensity
Innovation strategy	• Entrepreneurial orientation • Transformational leadership • Top management's attention to innovation projects • Top management's responsibility for innovation projects
Culture and structure	• Organizational climate • Participative leadership
Idea and knowledge management	• Number of high-quality ideas generated within a unit • Number of ideas generated that end up being selected and funded • Average time from idea submission to feedback • Number of ideas generated that end up being selected and funded • Customer integration
Portfolio management	• Innovation portfolio value • Profitability index • Number of projects initiated by the business unit but done with the innovation center • Portfolio balance
Project management	• Number of projects launched on schedule • Number of projects successfully transferred into business units • Time-to-market leadership • Extra budget successfully secured for innovation projects
Outputs and outcomes	• Sales profitability or savings arising from innovations • Number of sales revenues from new products/ services • Percentage of projects commercially successful • Number of users/ adopters • Number of startups/spin-offs generated out innovation activities

2.5.3.8. The Signposts of Innovation Framework

The signpost framework was developed by Hao et al. as a combination of the Oslo framework and the model of Dulkeith and Schepurek. Financial performance is located in the center of the signpost framework because the primary purpose of the innovation is to achieve economic benefits (Hao et al. 2017). The framework is

composed of six signposts, and innovation performance is evaluated for country level and company level separately by using different metrics (Hao et al. 2017). However, since this research does not concern the country level assessment, only the company level metrics will be mentioned. In Figure 2.9, the visual representation of the framework is presented. The first signpost is technology, which involves the most commonly used metrics. A number of innovative ideas, number of patents and R&D expenditure are among the technology related metrics at the company level (Hao et al. 2017). The second signpost, which is digitization, is related to the use and implementation of information and communication technologies (ICT), internet and digital technologies. The number of IT staff, IT expenditure and percentage of documents digitally archived are the examples of digitization metrics (Hao et al. 2017). Customer experience and branding, which constitute the third signpost, reflect the contribution of customers in innovation and have great importance in the innovation process. As presented in the study of Hao et al. (2017), since the customer related metrics have a direct effect both on today's and future's innovation outputs, such as revenue, authorities think customer experience as one of the important metrics. Advertising expenses, brand power and reputation, and customer satisfaction are the measures for this signpost (Hao et al. 2017). In the fourth signpost, the environmental and social sustainability, which generates challenges and hence opportunities for innovation, are discussed (Hao et al. 2017). Possible metrics for this signpost are a reduction in waste, water, energy and electricity consumption, and atmospheric emissions (Hao et al. 2017). The fifth signpost is internal innovation networks, which is one of the fundamentals of the innovation process. According to the perspective of Hao et al. (2017), a company is likely to achieve innovation success, if it establishes and improves internal relationships. Access to information, cooperative teams, funding for innovation and organizational structure are some example metrics for internal innovation networks (Hao et al. 2017). In addition to the internal networks, the environment beyond the boundaries of the company is very important in the innovation process (Hao et al. 2017). Therefore, the last signpost is external innovation ecosystem and involves the externally developed relationships, external factors that

affect the process and the market condition. Possible metrics for this signpost are the number of cooperated innovation projects, participation in innovation platforms and joint funding of innovation expenses with third parties (Hao et al. 2017).

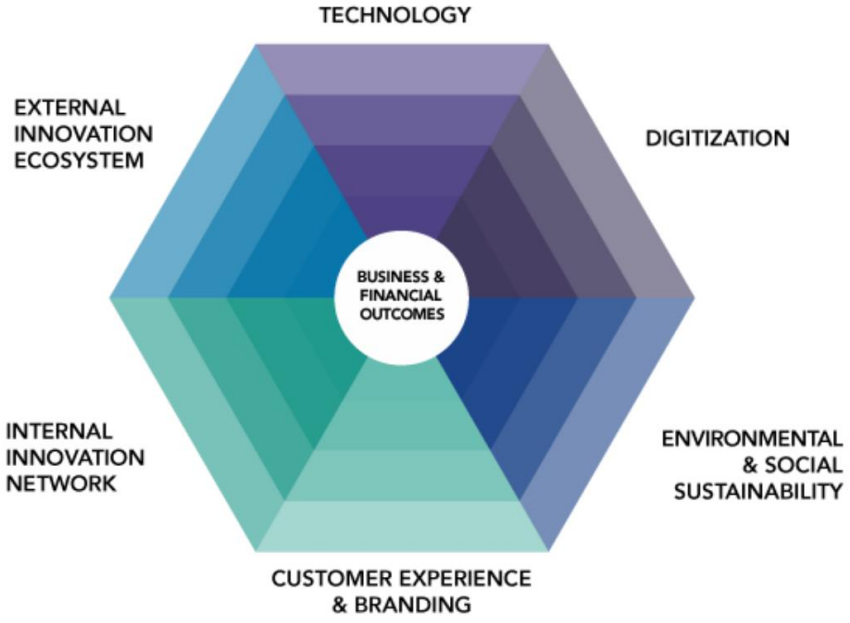

Figure 2.9. The Signposts of Innovation Framework (Hao et al. 2017)

With the signposts of innovation framework, Hao et al. have aimed to provide multiple dimensions with a variety of metrics for different industries. However, collecting data based on these metrics is not an easy task and requires further action. Therefore, it may not be practical for industry use.

As a result of the literature survey presented in chapter 2, it was revealed that many scholars and organizations in the literature have tried to define innovation which is actually an abstract concept. Although it was defined with different words, the definitions are consistent with each other and emphasized two points; creation or adoption of new ideas (new at least for the company) and requirement of commercial use of these ideas. In this regard, beyond defining innovation, they have classified innovation to make it more tangible and understandable. There are different classifications available in the literature, but most of the classifications have shaped

around the classification of Schumpeter. The definition and classification of OECD, which are the reference to this research, are among the well-accepted ones. As the companies started to comprehend the importance of innovation in gaining profit and competitive advantage, they have worked to make innovation a part of their businesses. In the business, as in every investment that involves money and time, the need for assessing the performance of innovation activities emerges. As a result of this need, different assessment frameworks and metrics have been proposed by various organizations and scholars. However, these frameworks are not that practical for use in the industry where most of the companies consider collecting and analyzing data for assessment as time consumption. Therefore, the literature review has revealed the need for an assessment model that is appropriate for industry use.

In this chapter, the innovation concept was investigated in a general manner and information presented here is valid mostly for product-based industries. However, in project-based industries like the construction industry, due to their unique characteristics and different focuses, a different perspective is required. In the next chapter, the findings about the innovation concept in the construction industry are presented.

CHAPTER 3

INNOVATION IN CONSTRUCTION

3.1. Innovation in the Construction Industry

Innovation in the construction is a process where new components of construction product form from new ideas that add value to the construction company in terms of the economy, the function of the product or technology (Motawa et al. 1999). Slaughter (1998) defines construction innovation as "*actual use of a non-trivial change and improvement in a process, product, or system that is novel to the institution developing the change*". Dikmen et al. (2005) provide a more comprehensive perspective for the innovation in construction and consider all significant improvements in company's business that add value to the customer, provide financial benefits to stakeholders and stronger competitive position to the company as innovation. Some researchers (Sergeeva, 2017; Green & Sergeeva, 2019) suggest that innovation is an abstract term and reification is required. In the study of Sergeeva (2017), the impact of narration on the innovation process and the way of construction companies to label the projects as innovative in the construction industry were investigated. In the study, it was argued that projects are classified as innovative based on the reflections of the innovation practitioners and as so to highlight the different characteristics of the project and to address the customer needs. According to the study, understanding the innovation practitioners' perspective on innovation concept will help in developing innovation strategies and management methods (Sergeeva, 2017).

The significance of the innovation in the construction industry is highlighted by many scholars in the literature. In the construction industry, benefits of the innovation can be observed either at the firm level or at the project level (Ozorhon et al. 2015;

Ozorhon & Oral, 2017). Possible benefits of innovation at the project level may be the increase in productivity and client satisfaction and a decrease in the project cost and time (Ozorhon & Oral, 2017). Better company image, improved technical and managerial skills and gaining experience are among the most important firm level benefits of construction innovation (Ozorhon et al., 2015). Based on the Ozorhon's another study (2013), it was proved that construction companies reduce the project completion time, waste and adverse environmental effects while improving the quality and health and safety by innovating.

In addition to providing economic benefits to the companies, stabilizing their positions or even surviving in the market can be the motivation for the construction companies to innovate (Sexton & Barrett, 2003a). It is known that problems in delivery time, quality, and price of construction projects cause client dissatisfaction in the construction industry (Seaden et al. 2003; The Economist, 2000; DETR as cited in Sexton & Barrett, 2003b). According to the study of Ozorhon (2013), firms can deal with these problems better when they innovate.

In the literature, whether the innovation occurrence in the construction industry is rare or not is a controversial issue. On the one hand, the construction industry is criticized for its limited innovative activities. The Business Roundtable (as cited in Nam & Tatum, 1997), argued that the absence of a sufficient number of innovative application in the industry is not due to the lack of innovative capabilities of construction companies or the customer demands, but due to the inability to coordinate these two. On the other hand, as opposed to this perception, Winch (1998) argues that construction industry persistently creates new ideas, but the reason why it seems there is an insufficient level of innovativeness in the construction industry is the rate of innovation that is relatively lower than most of the other sectors. According to Loosemore (2015), generally, the large-scale innovations rarely realize in the construction industry, but the incremental developments frequently occur. Slaughter (1998) supports this idea and discusses that innovations occur continuously in the construction industry and its related markets. When the construction industry is

considered as a system with many participants in the project, a change in one component of the system will affect another component or even the whole system (Miozzo & Dewick, 2002). Therefore, by considering a large number of sub-sectors of the construction industry, it would not be wrong to say that innovations have been continuously realized in the construction industry (Porter as cited in Seaden et al. 2003).

Slaughter (1998) developed a classification system, particularly for the innovations in the construction. In her approach innovations are classified according to the magnitude of change and the changes in links between components and systems (Slaughter, 1998). In Figure 3.1 types of construction innovation are visualized by putting on a scale based on the magnitude of change. Incremental innovations where the small changes occur and radical innovations where the breakthroughs in current knowledge and technology occur are the two ends of the scale (Slaughter, 1998). Incremental innovations perpetually occur in the construction industry (Gann, 1994, as cited in Miozzo & Dewick, 2002) and are generally based on the firm-specific and existing knowledge (Blayse & Manley, 2004). In radical innovations which occur much rarer and involve more risks; however, external knowledge sources and more complex relations with external institutions are required (Miozzo & Dewick, 2002). Radical innovations include significant changes in both the components and the linkages between these components and systems (Slaughter, 1998). In both modular and architectural innovations, significant changes occur, but the distinction between these two types is made based on the degree of change in the links between components (Slaughter, 1998). In modular innovations change occurs in the components or the concept, on the other hand, in architectural innovations linkages between systems or components change, while the changes in the components are limited (Slaughter, 1998). Lastly, in system innovations, improved performance or new functions are achieved as a result of the successful integration of multiple innovations (Slaughter, 1998). According to Slaughter (1998), system innovations are observed more often due to the project-based nature of the construction industry. Because each project

allows for reconfiguration of individual innovations according to the need of the project and a new function or an improved performance can be achieved in each different projects.

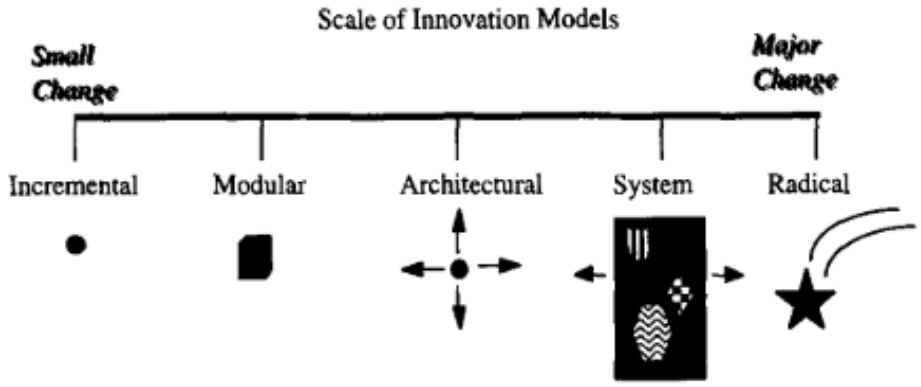

Figure 3.1. Classification of Innovation for the Construction Industry (Slaugter, 1998)

The construction industry can be considered as among the traditional industries with lower technological developments and laboratory works. Also, project-based and unique nature of the industry distinguishes construction industry from the manufacturing industry and necessitates more specific innovation models. Winch (1998) proposes that innovation in the construction industry can be realized either by the adoption of new ideas or as a solution for a particular problem. As visualized in Figure 3.2, the innovation process may follow different paths when the starting points are different.

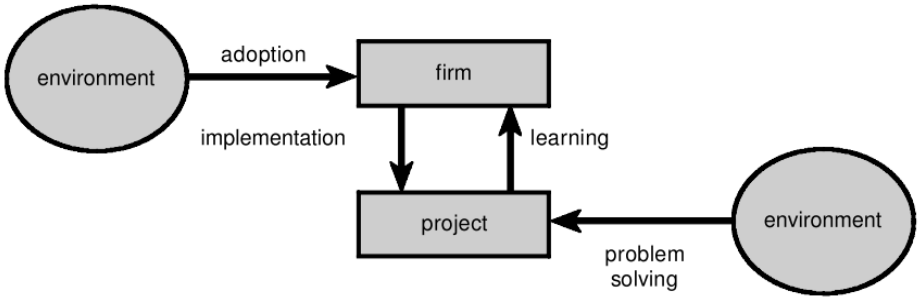

Figure 3.2. Model of Construction Innovation (Winch, 1998)

Dikmen et al. (2005) have developed another model to explain the innovation system in the construction industry in a more comprehensive way. In the model, the effects of various factors on the innovation process are emphasized. According to the framework shown in Figure 3.3, the success of companies in reaching their objectives through appropriate strategies also depends on the organizational and external factors that may have either positive or negative impact on innovation process (Dikmen et al. 2005). Therefore, as Dikmen et al. (2005) have proposed, when the innovation in the construction industry is investigated, the barriers and drivers are also be considered.

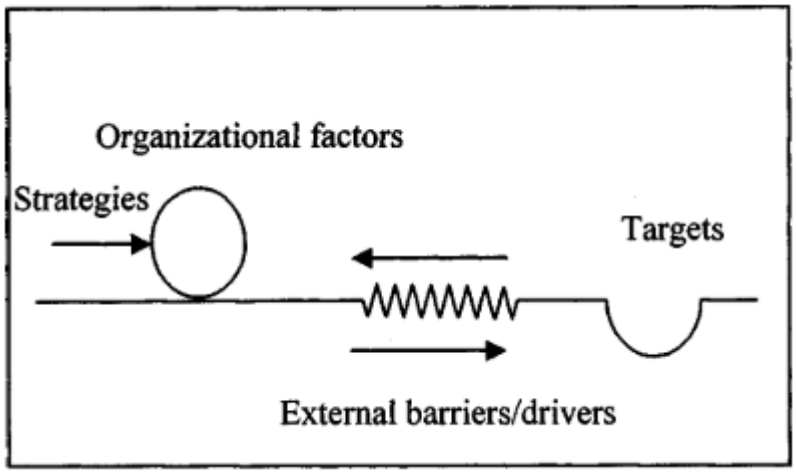

Figure 3.3. Model of the Innovation System in Construction (Dikmen et al. 2005)

As suggested by Dikmen et al. (2005), the drivers and barriers to innovation in construction were investigated to understand the innovation mechanism of the construction industry. In the following section, these drivers and barriers are presented.

3.2. Factors Affecting the Innovation Activities in the Construction Industry

3.2.1. Obstacles to Innovation in the Construction Industry

The main characteristics of the construction industry and construction projects are among the major factors that determine the driving and impeding factors of construction innovation. The time and budget constraints in construction projects are the main hindrances for construction companies to use new methods or approaches

(Ozorhon et al. 2015). Considering the fact that the financial resources are one of the main inputs of innovation, limited budget and time cause companies (especially the small companies) to tend to prefer traditional methods. One of the respondents in Loosemore's study (2015) stated that the time is such limited that there is no time for creating and applying new ideas on site when they are making an effort to finish the project on time and within budget. However, in contrast to this tendency, the results of the studies show that innovations help construction companies to shorten the construction period and to reduce the construction costs (Ozorhon, 2013).

In the Oslo Manual (OECD, 2005), it is stated that when the lifecycle of the product becomes shorter, the frequency of innovation occurrence increases. However, high durability and long lifetime are desired in the end product of construction projects. In construction products, in addition to the interaction of components with each other, they also interact continuously with the external environment. Therefore, before using new methods or technology, some time is required for the testing and learning process (Bygballe & Ingemansson, 2014). The most accurate results about the reliability of a new practice can be obtained by using a full-scale prototype, but when the physical scale of the construction products is considered these tests are costly and time-consuming (Slaughter, 1998). Most of the time customers do not want to take the risk and to be the first experiencer (Loosemore, 2015). Therefore, companies prefer to use traditional methods and tested techniques in their projects, and also by considering the need for maintenance and the stock of spare parts for maintenance, they generally avoid to use new products or methods (Pries & Janszen, 1995; Blayse & Manley, 2004). However, Ivory (as cited in Kulatunga et al. 2006) emphasizes that this risk-averse attitude of companies toward new approaches will cause a negative effect on companies in the long-term.

The unique nature of construction projects is criticized as an obstacle to innovation because due to the unique conditions, most of the time activities of construction companies cannot go further than the optimization of the processes (Pries & Janszen, 1995; Kulatunga et al. 2006). Sometimes innovation occurs as a form of a solution for

a particular problem in the construction site. Nevertheless, in order to become an innovation, this solution should be learned, codified and transferred to another project (Winch, 1998; Sexton & Barrett, 2003a). Due to the difficulties in transferring the innovation to the next project, generally, companies are not willing to allocate both their money and time to these new ideas (Blayse & Manley as cited in Sariola, 2018). The inability of construction companies to form a long-term relationship is one of the apparent hindrances in the way of construction innovation (Sexton & Barrett, 2003b). Because of the temporary relationships and, insufficient communication and documentation, learnings from the previous projects cannot be transferred to the future projects and are generally lost (Blayse & Manley, 2004; Miozzo & Dewick, 2002). Also, the temporary nature of the construction projects and the limited time do not allow to transfer the past experience to future projects (Bygballe & Ingemansson, 2014). Discontinuities in knowledge transfer cause inhibition of diffusion of new ideas and hence inhibition of innovation. Also, the involvement of many parties in construction projects entails the interorganizational negotiations and managing complex networks for innovative activities (Slaughter, 1998; Winch, 1998; Miozzo & Dewick, 2002) which makes the innovation process more complicated and difficult.

The government has a more dominant effect on the construction industry in comparison with most of the other sectors. Therefore, its impact cannot be neglected in construction innovation. In the study of Miozzo and Dewick (2002), it was argued that the government is the main information source and the primary encouraging force for the innovation in construction. Governments can create an environment where innovative activities are encouraged by supporting relations and collaborations between contractors and institutions (Miozzo & Dewick, 2002). However, according to Dubois and Gadde (2002), most of the governments' standards have a negative effect on innovation. Especially, technical and environmental regulations set standards for construction activities, prevent companies from acting out these standards and allow limited variation (Blayse & Manley, 2004). In addition to impedient effects of regulations, the economic policies of the governments may hinder the innovative

activities of construction companies by not enabling to create a stable economic environment for investments in long-term projects (Miozzo & Dewick, 2002; Loosemore, 2015). Gann et al. (1998), suggest that a strategic approach that encourages innovation and creative practices should be followed in the creation of regulations and standards. So, a positive governmental effect may be created on companies' innovative activities.

The attitude of the company's top management towards innovation including the punishment and reward system has a considerable impact on innovation performance. If the company takes a stiff attitude towards new approaches, this may cause a deterrent effect. In the study of Kulatunga et al. (2006), as stated by the project managers, due to the concerns about the going out of the company policies and project goals, innovative activities are avoided.

One of the main reasons why construction companies do not innovate is the unclear observability of the benefits of innovation in the short run (Ozorhon et al. 2015). In the long term, the repeatability of the innovations in multiple projects has a significant effect on companies when they decide to innovate (Ozorhon, 2013). Because, generally, companies try to standardize their activities in the business, but in project-based industries, systematizing the process is not easy due to their bespoke and unique nature (Gann & Salter, 2000). Therefore, in the construction industry, in order to ensure the repeatability of new practices, it is essential to integrate the learnings and experiences from past projects to company's business (Gann & Salter, 2000). As Ozorhon & Oral (2017) suggested, the results of the innovation process can be obtained in long-term, and when the companies follow the appropriate innovation strategy, they may have a chance to apply same innovations in similar future projects.

Other significant barriers in the way of innovating in the construction industry are the traditionally used project procurement methods, delivery methods, and contract types. In the study of Dubois and Gadde (as cited in Bygballe & Ingemansson, 2014), it is emphasized that the commonly used lump sum contracts entail the price-based

competition rather than the performance-based competition. In the price-based tendering method, the selection of the contractor is made only based on the minimum price instead of many important criteria such as experience, employee skills, and financial stability, etc. (Ozorhon, 2013). In order not to exceed the defined budget, companies keep away from trying new methods. Although the existing methods appear to be the most effective solutions in the short term, in the long term; however, they do not make any contribution to the company (Bygballe & Ingemansson, 2014). Eriksson (as cited in Sariola, 2018) suggests that to improve both the relationship between parties and the innovation performance, alternative relationship-based methods like strategic partnering or alliancing may be used. By this way, the trust and communication between project participants can be improved (Loosemore, 2015). The early involvement of the participants in the construction process is another important issue in the development of innovation (Ozorhon, 2013). Because, a collaboration between companies, especially between the large companies, is generally hard to provide and it can only be realized by the early involvement of the parties in the solution development process (Loosemore, 2015). However, in DBB (Design-Bid-Build), which is the most commonly used project delivery method, the contractor gets involved in the project after the design stage is completed which results in the isolation of the design and construction stages from each other (Murphy et al. 2015). Studies show that the divergence of these major phases decelerates both the construction process and the innovation process and causes lower control over the project (Murphy et al. 2015) and little commitment and trust to the project and innovation activities. In order to overcome this situation companies may prefer alternative methods like DB (Design-Build), that enable the phase overlap and provide more flexible project environment (Gambatese & Hallowell, 2011). In this way, contractors may have more control over the construction process and be more active in innovation activities. Changing the use of traditional methods may be challenging for companies, and the effects of it cannot be observed in the short term, but when they establish the right strategic relationships, benefits and strong competitive positions can be obtained in the long term.

3.2.2. Motives for Innovation in the Construction Industry

As many scholars agreed, one of the strongest driving force in construction innovation is the experienced customers who have advanced demands (Winch, 1998; Barlow as cited in Blayse & Manley, 2004; Dikmen et al. 2005; Bygballe & Ingemansson, 2014; Ozorhon & Oral, 2017). Customers may have an influence on the innovation performance of construction companies in many different ways. They can force project participants for improved building performance, higher quality of work, novel project characteristics and hence for innovative approaches and practices (Blayse & Manley, 2004). In this process, the attitude of the customer towards innovative approaches has a significant impact. The commitment of customer to innovation, risk sharing and involvement of customers in the innovation process in many different ways will have a positive effect on the innovative activities of construction companies (Nam & Tatum, as cited in Kulatunga et al. 2006). In addition, when the customers are willing to pay for new ideas, they may create pressure on the companies to think in an innovative way by using their purchasing power (Loosemore, 2015).

As opposed to the discussion in the previous section about the uniqueness of the construction industry, it is also argued in the literature that the unique demands in the projects provide an appropriate basis for the new practices and experiments (Blayse & Manley, 2004; Kulatunga et al. 2006; Sergeeva, 2017). Due to the unique nature of the construction projects, different problems that are faced in the construction site may facilitate innovative solutions. To solve these unique problems different resources (both human and physical resources) are utilized in each different project which promotes variety in innovation activities (Bygballe & Ingemansson, 2014). At that point, the role of the project employees is critical, because they are the carriers and the diffusers of the new ideas and internally generated knowledge (Ozorhon & Oral, 2017).

Improved relationships and cooperation between construction project participants considerably influence the innovativeness in the construction industry (Dikmen et al.

2005; Sariola, 2018). Because, innovativeness of companies can only be sustained by maintaining the innovative contacts and information flow from innovative sources (Sexton & Barrett, 2003b). The statistics show that 60% of innovations are realized as a result of cooperation between different parties (Pries & Janszen, 1995). According to Grabher (as cited in Bygballe & Ingemansson, 2014), the multi-party nature of the construction industry enables to transfer knowledge between different parties and disciplines which provide the proper environment for innovation generation and diffusion. In the innovation process, long-term relationships help companies to generate and transfer knowledge easily (Ozorhon, 2013). As Rutten et al. (2009) suggested, the cooperation between parties involved in the construction project opens up a way for innovations. Barlow et al. (as cited in Ozorhon, 2013) explain the reason behind this as the partners' approach to benefit from innovative solutions mutually. A good example of long-term relationship application can be given from the study of Bygballe and Ingemansson (2014). In their research, one of the construction companies has chosen to work with only one supplier who is an expert in its field, instead of working with multiple suppliers. So that, the innovative methods can be applied in the process as a standard procedure which enables to transfer innovations in their future projects. Also, in the case study of Ozorhon (2013), it was revealed that the innovative construction companies have established strategic alliances for carrying out their innovative activities in higher quality with less money and in a shorter time.

The driving effect of the improved communication within the company and between the parties is also highlighted in the literature. Different studies in the literature emphasized the significant impact of narration and storytelling as communication methods on the innovation process (Sergeeva, 2013; Sergeeva & Trifilova, 2018). According to the research of Sergeeva and Trifilova (2018), storytelling helps innovation idea to attract attention and to be approved by top management at the early stage of the process and to diffuse within the company and among other companies at the next step. Also, while the narratives about successful innovations improve the reputation of the innovative company, the stories about failed innovation attempts

contribute to the learning of the company (Sergeeva & Trifilova, 2018). According to the findings of another research carried out by Sergeeva (2017), the communication with the customers helps to create a commitment to the common goal and trigger the innovation.

The organizational structure of companies including innovation diffusion practices, knowledge transfers mechanisms, level of centralization and external links also has a significant impact on the innovation performance (Miozzo & Dewick, 2002; Dikmen et al. 2005). For example, organizations who have a more flexible structure are adapting new approaches better (Kulatunga et al. 2006). Because, flexibility in organizations provides employees more independence in decision making and opportunity to release individual creativity which motivates the innovation generation (OECD, 2005; Martínez-Román et al. 2017). Also, the positive attitude of the top management of the company or the project towards innovation helps companies to achieve successful innovations (Kulatunga et al. 2006). Dodgson (as cited in Ozorhon & Oral, 2017), suggests that the tolerant and supportive attitude of top management towards new approaches encourages the creation of innovative ideas. Existence of the innovation champion or the leader is another important issue in the innovation process (Sexton & Barrett, 2003b; Dikmen et al. 2005). Dulaimi (as cited in Kulatunga et al. 2006) emphasizes the significant role of the leaders in the innovation process and suggests them to take responsibility and a reasonable amount of risk. In addition, clearly informing the team or the employees about the objective of the innovation and the process increases the commitment of them to the innovation and hence the possibility of successful innovation (Kulatunga et al. 2006).

In contrast to their impedient effects, the governments and the regulations may enforce companies to innovate by obliging them to meet performance standards (Ozorhon & Oral, 2017). According to Bygballe and Ingemansson (2014), while the prescriptive regulations hinder the innovation, the regulations that are based on the performance criteria actually force companies to innovate. For example, environmental regulations generally force companies to invest in using advanced techniques and materials

(Barata & Fontainha, 2017). In addition, the government may support innovative activities and R&D studies through arrangements in tax policies, for example, deducting the corporation taxes for R&D (Martínez-Román et al. 2017).

3.3. Innovation Performance Assessment in the Construction Industry

Innovation process requires the allocation of both human resources and physical resources of the company, and therefore it requires the investment of money and time. As it was highlighted in the previous chapter, every activity in which a certain amount of money and time are invested, also requires a performance assessment to see the outcomes of these investments clearly. In the study of Sergeeva (2013), one of the interviewees was highlighted the importance and necessity of the IPA in the construction industry. As the interviewee stated, the partners of the project and hence of the proposed innovation want to see the cost and the financial benefits of this innovation. In other words, the requirement of assessing the effectiveness of the innovation was emphasized by the professionals.

As suggested in the Oslo Manual (OECD, 2005), in IPA, using non-R&D metrics is quite reasonable because, in traditional industries where the technological developments are low, the vast majority of the companies do not invest in the experimental and laboratory-based works (Loosemore, 2015). The construction industry is among these traditional industries where technological developments and experiments are relatively low when compared with most of the other industries. According to Loosemore (2015), the non-innovative image of the construction industry is due to the inappropriate innovation assessment methods, which are mostly based on R&D activities. In the construction industry, many innovations are realized by innovation adoption from other companies. Therefore R&D related indicators might not be sufficient to capture these innovations (Ozorhon & Oral, 2017). In addition, in Miozzo and Dewick's study (2002), responders stated that R&D funding alone is not a good indicator for IPA since these investments are small amounts when compared to the turnover of the company. In the study of Green and Sergeeva (2019),

they present a soft approach and argue that creative projects cannot be evaluated by using qualitative metrics. Therefore, a broader perspective is needed to reflect the actual innovation performance (Winch, 1998).

In the literature, there is a very limited number of studies concerning the IPA in the construction industry. Ilter (2009) has developed a methodological framework for the IPA of Turkish contractors. In the study, data related with the traditional indicators provided by Turkish Statistics Institute like R&D expenditure, ICT investments, number of R&D projects, number of patents and number of citations from related scientific publications, number of researcher etc. which are stated as insufficient for assessing the actual innovation performance in the construction industry by many researchers were used for IPA. Also, within the scope of the research IPA was done at the industry level and did not reflect the performance of an individual company or project. Ghaben and Jaaron (2015) investigated the IPA in project management practices of construction projects in a certain region. In the study, possible innovations in the project management practices were grouped under four main categories, and the professionals were wanted to assess the projects by considering these categories. Although it has a comprehensive approach to IPA in project management practices, being limited to assess the project management innovations only, the proposed method is not appropriate to understand the actual innovativeness level of the construction projects. As another approach, Manuylenko et al. (2015) suggested that the way of companies to define innovation has determining role in the development of a methodological basis for the IPA.

Literature review about innovation in the construction industry showed that innovation process in the construction industry is a kind of puzzle, which comprises of many different parts like unique characteristics of the project, project participants, environmental factors and the unique characteristics of the construction industry itself. Therefore, when considering innovation in the construction industry, a broader perspective should be developed. As suggested by the advocates of the soft approach, innovation cannot be measured by using traditional qualitative metrics. In addition,

many scholars emphasize that innovation occurrence in the construction industry is not rare but hard to catch. So, it was revealed that there is a lack of model in the literature that helps to understand the innovation mechanism of the construction industry and to assess the innovation performance of construction companies. In the next chapter, the major gap in the construction innovation body of knowledge and the proposed solution for this gap are presented.

CHAPTER 4

RESEARCH OBJECTIVE AND METHODOLOGY

4.1. Research Objective and Aims

In the light of the findings from the in-depth literature review, the importance of IPA and the lack of an appropriate model for the construction industry were revealed. Therefore, finding an assessment framework to explore innovation in the construction industry is the primary objective of this study.

Importance of the innovation assessment is highlighted in the literature. However, as argued by many scholars, there is a knowledge gap in the study of IPA and the assessment indicators (Kulatunga et al. 2006; Hao et al. 2017). Companies are confronting problems in applying available theoretical innovation assessment models into real activities (Murphy et al. 2015). One of the aims of this study is proposing an innovation assessment model that is practical for industry use.

Lack of the general best model and sector-specific models for the construction industry is another gap in the literature (Martínez-Román et al. 2017). Models for industries with intense technologic practices where most of the related studies concentrate on are not appropriate for the construction industry. One of the aims of this research is proposing a housing sector-specific assessment model, which can be used for other subsectors with some modifications.

One of the major problems in innovation assessment is the over dependency to assessment metrics (Hao et al. 2017). Usual metrics used in the technology-driven sectors are generally not work in the other low-tech industries (Barata & Fontainha, 2017). By its nature, the construction industry is one of the industries where these standard innovation assessment indicators are not sufficient in reflecting the actual performance (Dikmen et al. 2005; Barrett et al. as cited in Ozorhon & Oral, 2017). For

example, the standard indicators fall short of assessing the managerial innovations that are frequently realized in the construction industry (Bygballe & Ingemansson, 2014). One of the aims of this study is to broaden the companies' viewpoints and to remove borders that are determined by the standard metrics. Therefore, in this study, due to the uncertainties about assessment metrics (Andrew et al. 2009; Hao et al. 2017) and difficulties in getting and recording quantitative data about innovation expenditures, the performance assessment has been done in terms of the degree of novelty of successful innovations.

Needs emerged in projects are the actual determinants of the new ideas or approaches in the construction industry (Ozorhon & Oral, 2017). Therefore, investigating the innovation performance of construction companies in project level is more appropriate than the firm level investigation. However, in the literature, most of the assessments have focused on the firm level performance and mostly due to the difficulties in catching the innovative activities in the construction site, which are carried out by different project participants in different stages, project level investigation is left aside (Ozorhon, 2013). In this study, it is aimed to help companies to follow these innovations by presenting the possible innovation areas for the housing projects at the project level.

Because of all these reasons alternative innovation assessment models are required for capturing the actual innovation performance of the construction companies.

4.2. Research Methodology

In this section, the methodology of the research is explained and presented in the flow chart below.

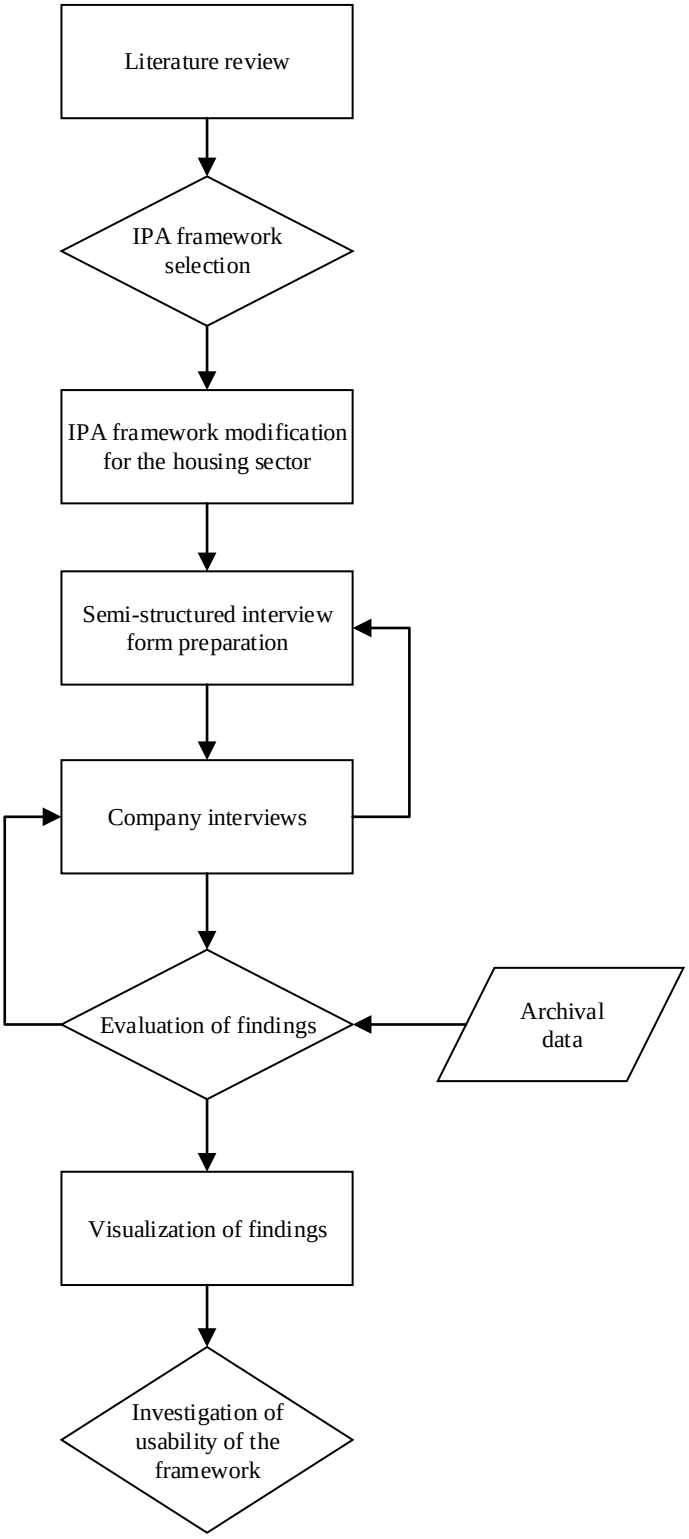

Figure 4.1. Research Methodology Flow Chart

In the first step of this research, in order to gather information about the innovation concept and the methods of IPA, and to identify the knowledge gaps in the literature, a detailed literature review was conducted. As a result of a part of the literature review the advantageous and disadvantageous sides of the assessment models, which were mentioned in Chapter 2, were evaluated and the summary of the evaluation is presented in Table 4.1. As a result of the evaluation, IR was selected as the base framework for using in the research. The reasons why IR was selected can be briefly explained as follows:

- Its broader view of innovation enables companies from different industries to use for assessing the different types of innovation.
- It enables to represent the results of data analysis visually and makes the outputs more understandable.
- Since it provides a sample questionnaire and presents possible innovation fields in a broader view, it is relatively more appropriate for use in the industry.

Table 4.1. *Evaluation of Innovation Assessment Frameworks*

	Innovation Dynamo	Innovation Radar	Innovation Value Chain	Innovation Funnel	Innovation Audit	Model of Ten Types of Innovation	Model of Dulkeith and Schepurek	Signposts of Innovation Framework
Can be used for different types of innovation.	-	+	+	+	+	+	+	+
Can visualize the data.	-	+	-	-	+	+	-	-
KPIs or assessment metrics are provided.	+	+	+	+	+	+	+	+
Can be used for different industries.	-	+	+	+	+	+	+	+
Practical for industry use.	-	+	-	-	-	+	-	-

After selecting IR as the base framework, it was modified for using particularly in the housing sector. The reasons for focusing mainly on the housing sector can be listed as follows;

- According to the construction market survey of Turner & Townsend (2017), the housing sector is continuing its growth all around the world. Likewise, its effect on the world's economy is growing.
- Housing sector accounts for a large share of investment and employment. In Turkey, according to the data from the Ministry of Development, in 2016 the housing sector constituted 15% of fixed capital investment and 7.7% of total employment (A&T Bank, 2016).

Therefore, by considering both its direct and indirect effects on the economy and its continuous growth, changes and improvements in the housing industry will influence significantly the country as well as the housing sector itself. Also, among other sub-sectors of the construction industry, housing sector is the closest to manufacturing industry in terms of the development and sales processes. Like in manufacturing industry, in the housing sector, the product, in our case the product is individual housing unit, is designed, developed and sold to customers. Therefore, innovation development and the management practices can be observed relatively more clear in different phases of the housing projects. So, it is important to investigate the innovation process and innovation management practices in this specific sector. When the Innovation Radar was adapted in the housing sector, an in-depth literature review was done, and the dimensions of the new model were decided based on this review. Details about the model and its dimensions are presented in Chapter 5. After completing the modification of the new model, the research method and data collection method were decided as a case study and semi-structured interviews with authorities respectively. When the aim is exploring and understanding complex phenomena, in our case the innovation and IPA processes in the construction companies, in-depth case study becomes the most appropriate research method. As explained in the book of Yin (2009, p.10), one of the most effective ways of deciding on the research method is to determine the research question. As Cooper suggested (as cited in Yin, 2009, p.14), making literature review is one of the most effective practices when determining the research question. The main concern of this research is to find a framework that can be used in innovation assessment in the construction industry. Then the

research question becomes basically “How can the innovation performance of the construction companies be assessed at the project level?” If the research question mainly focuses on “how” and “why” questions and the research mainly concerns the contemporary events over which the investigator has little or no control, conducting a case study should be preferred as the research method (Yin, 2009, p.9). Although, a certain case is the focus and generalization of the findings may be disputable in the case studies, their ability to enable in depth research and investigation about a particular problem makes case studies one of the strongest research methods for such studies. Also, another major strength of case studies over other research methods is a variety of data collection methods such as archival resources, observations, and interviews that can be used in this method (Yin, 2009, p.11). In the research, data is decided to be collected through interviews with company authorities, which is one of the most important sources of case study information (Yin, 2009, p. 106). Therefore, in the next step semi-structured interview forms were prepared (See Appendix A). The interview form was developed based on the literature review. In the interview form, opinion questions were included to allow the respondents to qualify and explain their answers. After completing the interview form, the company that will be work together was selected. The selected company whose main office is located in Ankara is one of the largest and the most well-known contractors in Turkey. In the next step, semi-structured interviews were carried out with the company for data collection. Details about company and company interviews are included in Chapter 6. As can be seen in research methodology flow chart, there was a feedback loop between interview form preparation and company interviews steps which means that in the light of the feedback provided by the company, interview form was revised and put into a final form. Then, in the light of the collected data, findings were evaluated. Again, in order to clarify some unclear points or explanations in the interview forms, there was a feedback loop between the evaluation of findings and company interviews steps. After finalizing the evaluation step, findings were visualized by using the proposed model, which is mentioned in the next chapter in

detail. In the last step, the usability of the model was investigated through an additional interview. In this interview, the possible usage fields and recommendations for the improvement of the model were investigated.

In the following chapters, the details of the research steps are presented. In chapter 5, the conceptual model and the expected benefits of the model are explained. Then, the usability of the model was tested with a case study and the general information about the study, and the company is presented in chapter 6. Next, the findings of the study are evaluated and presented in chapter 7. Finally, in Chapter 8 the results are discussed in the light of the findings from the last interview.

CHAPTER 5

THE PROPOSED FRAMEWORK: INNOVATION CATCHER

Construction projects are carried out with the cooperation of many parties like contractors, suppliers, sub-contractors, consultants and clients. Therefore, in order to reveal the actual innovation performance in the construction industry, the innovation analysis should be done in the project level instead of the firm level (Ozorhon, 2013). Innovation Catcher (see Figure 5.1) which was adapted from Innovation Radar (Sawhney et al. 2006) aims to catch the innovations in different fields of a housing project at the project level. Therefore, Innovation Catcher was created considering the possible fields that innovations can be realized in a "housing project."

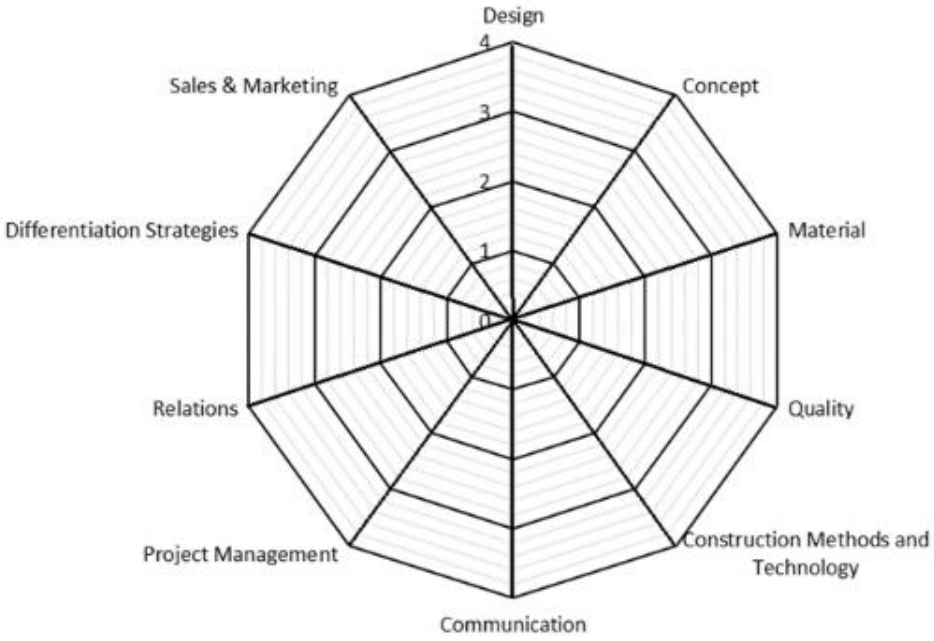

Figure 5.1. Innovation Catcher

The dimensions of the Innovation Catcher were determined through a detailed literature review. The Innovation Catcher (IC) considers the following 10 dimensions under four main innovation types for assessing innovation performance of the housing projects:

1. **Product Innovations**

In the IC product innovations are classified under 4 dimensions namely innovations in design, concept, material, and quality which are explained in detail below:

Design: Due to the sector characteristics of the construction industry, many innovations are realized in the design of the projects (Barata & Fontainha, 2017). Design of the housing project arises as a reflection of the market demand and technical capabilities of the company (Ozorhon & Oral, 2017). Since the complex design demands of clients force construction companies to innovate, design of the housing projects constitutes an important area in the innovation in the housing sector. When the housing projects are designed in a new or different manner, then the project would display difference (Barata & Fontainha, 2017).

According to the study of Slaughter (1998), in order to increase the value of their work, most of the construction companies are working on improvements and changes in the design of their projects. It is also common that in order to improve or further understand the design process, construction companies work together with research institutions (Miozzo & Dewick, 2002). Emerging technologies trigger companies to change the methods that they use in the design process (Seaden et al. 2003). The transition from hand drawing to computer-aided design is one of the best examples that support the results of the study of Seaden et al. (2003). With the emerging modeling and simulation technologies, companies tend towards implementing these technologies into their projects.

This dimension includes the improvements and changes in both the design of the projects and the technologies used in the design process.

Concept: According to the Oslo Manual (OECD, 2005), the concept and the social image of the housing project are as effective as the objective of the product in attracting the attention of the customers. For example, one of the Turkish companies was first in developing and constructing a suburban smart house complex with many different facilities inside the project and achieve considerable success with this project (Dikmen et al. 2005). Therefore, by considering the housing projects, change or improvements in concept would add great value to the project and catch the attention of the customers.

Material: Construction materials are seen as one of the most probable innovation areas in the construction industry by many scholars (Miozzo & Dewick, 2002; Barrett et al. 2008, p.11; Ozorhon et al. 2015). The product of the construction, in our case the housing buildings may differentiate by changes or improvements in the materials or components (Barata & Fontainha, 2017). Using advanced construction materials such as high-performance concrete, composite materials or recycled plastic components in structures is one of the common innovation practices among construction firms (Seaden et al. 2003). As a real-life example from the study of Miozzo and Dewick (2002), one of the most successful companies has carried out R&D studies related to advanced construction materials.

Recently, in order to decrease the adverse environmental effects of construction projects, many companies are working on sustainable and green building materials (Ozorohon & Oral, 2017). Therefore, with the increasing environmental awareness, change and improvements in construction materials constitute an important part of innovation in the housing sector.

Quality: According to Porter (as cited in Pries & Janszen, 1995), companies may gain a competitive advantage by increasing the quality of their work. The increase in sales and profitability cannot be achieved by offering lower prices alone; generally, they require improved quality (Tidd & Bessant, 2009). The results of the study of Seaden

et al. (2003) show that construction companies are carrying out innovation activities to increase the quality of their works.

2. Process Innovations

Innovations in construction methods and technology and communication are 2 dimensions of process innovations in the housing sector. Details of these dimensions are provided in the following sections.

Construction methods and technology: Changing or improving the construction techniques and methods are one of the common innovations in the construction industry (Ozorhon et al. 2015). Innovations in construction technology and material are considered as the main innovations in the construction industry by the contractors (Barrett et al. 2008, p.11). Environmental regulations and increasing environmental awareness cause companies to invest in advanced construction methods and technologies (Barata & Fontainha, 2017). For example, in the recent time, prefabrication in construction projects is one of the most efficient innovations in terms of decreasing the cost and waste (Bygballe & Ingemansson, 2014; Ozorhon et al. 2015). In the study of Seaden et al. (2003), it was revealed that companies are starting to orient towards the implementation of automated techniques and equipment in their construction methods.

Communication: Considerable amount of the cost of the building is somehow connected with the communication between parties and communication management process (Pries & Janszen, 1995). In order to solve the communication problems and to provide effective communication between project participants, construction companies have developed different practices such as creating a website for the project, holding weekly design meetings or group meetings (Ozorhon, 2013). Also, improvements in information and communication technologies constitute a significant part of the innovation activities of companies regardless of their activity field (Sexton & Barrett, 2003a). According to the study of Seaden et al. (2003), majority of the companies that participated in the study have focused on improvements in

communication technologies such as making e-mail usage widespread within the company, creating company computer networks (LAN or WAN), or creating portals. For example, in the study of Miozzo and Dewick (2002), one of the largest German construction companies has developed a communication system for more effective communication between the project participants in the large construction projects.

In brief, changes or improvements in communication networks and methods are investigated under this dimension.

3. Organizational Innovations

Organizational or managerial innovations in the housing sector are classified as innovations in project management practices and approaches, and relationships with the third parties.

Project management: Innovations in managerial practices are one of the key areas for improving the performance of the construction companies (Thomas & Bone as cited in Sexton & Barrett, 2003b). Organization and project management innovations are common among construction firms especially among small-scale ones (Sexton and Barrett, 2003a). In the study of Bygballe and Ingemansson (2014), it was revealed that construction companies innovate most in the management of the projects. According to Zavadskas et al. (as cited in Barata & Fontainha, 2017), different approaches are frequently developed in project management practices because of the sector characteristics of the construction industry. Application of lean principles in construction projects is among the managerial innovations that decrease the cost and time spent by eliminating the waste in the project (Ozorhon et al. 2015). With the increasing environmental concerns and awareness, many companies starting to work on constructing sustainable buildings and environment (Ozorhon, 2013). Therefore, this dimension should cover innovation activities related to sustainability management practices as well. The study of Seaden et al. (2003) showed that companies are starting to computerize their various management practices. For example, they are introducing different software for project management and cost management practices and

planning and scheduling (Seaden et al. 2003). It is also a remarkable finding from the study of Seaden et al. (2003) that the most commonly realized managerial innovation among the participants is changing their project delivery methods from DBB to DB and BOT.

So, this dimension involves innovations in project level managerial and organizational practices.

Relations: Thomas and Bone (as cited in Sexton & Barrett, 2003b) stated that establishing partnership relations is one of the main innovation areas in the construction industry. Establishing long-term relationships can be regarded as both the driving force for innovation and the innovation itself. Since the parties included in the project period share the same values, long-term relationships are part of the construction innovation process (Bygballe & Ingemansson, 2014). For example, companies may collaborate with other specialist companies when they are working in different geographies or may establish a long-term partnership with suppliers. As a real-life example to this dimension from the study of Miozzo and Dewick (2002), one of the worldwide known construction company has established a long term partnering relationship with a well-known electronics company for collaborating in the smart housing projects. The positive impacts of collaboration with universities or other research institutes on the performance of the company are also highlighted by many scholars (Miozzo & Dewick, 2002). Therefore, established relations with these organizations should take place under this dimension. However, it is important to distinguish that changing the organization that the relationship is established with, may not mean innovation, but changing the type or degree of relationship would constitute innovation (Sexton & Barrett, 2003a).

This dimension covers the innovations in relations established with the suppliers, sub-contractors, governmental organizations, financial institutions, universities, construction companies or any other organizations.

4. Marketing Innovations

Marketing innovations in the housing sector are classified as differentiation strategies and sales and marketing methods whose are explained in detail below.

Differentiation strategies: In the market, there are different customer groups with different needs. Companies should capable to respond to different needs to compete with the rivals. When they meet these needs, construction companies may differentiate through different strategies. According to the Oslo Manual (OECD, 2005), market innovations aim to increase the sale of the products through entering a new market, changing or improving the position of the product in the market or meeting the customers' needs better. For example, bundling of the products, in our case houses, with services is a popular approach among the construction firms that want to gain a competitive advantage over rivals and to offer customers increased product performance (Gann & Salter, 2000). Providing post-commissioning services like maintenance services or garden care services are one of the innovations that can be realized in the housing sector (Seaden et al. 2003). Also in the study of Dikmen et al. (2005), it was found that entering a new geographical market for the first time or diversification into a new market are commonly realized innovations in the housing sector. Being first in a market may provide greater market share to companies (Tidd & Bessant, 2009). As an example from the same study, one of the Turkish construction companies created a submarket by constructing a suburban luxurious living complex. Also, without changing the geographic market or major activity field, companies may increase the value of their projects by meeting the needs of customers that have never been met by other companies.

Sales and marketing: Differentiation efforts in marketing strategies are one of the most employed methods of construction companies in gaining a competitive advantage over their rivals. According to the study of Ozorhon and Oral (2017), innovation in marketing techniques is among the main innovation types realized by the Turkish construction companies. Through promotions, companies may improve

the image of their products and increase sales (OECD, 2005). For example, introducing a new promotion concept such as the first use of different media or technique for product promotion or celebrity endorsement may be among marketing innovations. Alternatively, companies may develop new pricing strategies to increase housing sales (OECD, 2005). For example, they may use demand-based pricing or provide credit for customers.

The primary mission of Innovation Catcher is to broaden the innovation perspective of companies specifically in the housing projects. This will help companies to solve two important problems: catching all the innovations realized in the housing projects regardless of their novelty degrees and gaining competitive advantage by differentiating their projects in different areas. Due to the narrow view of innovation in the construction industry, all construction companies tend to innovate in similar dimensions or a company maintains its innovation activities in the same dimension for years. Therefore, showing alternative innovation fields will help companies to strengthen their strategic positions in the market. Its ability of visualization without using complicated data is the major strength of Innovation Catcher, because, it makes the results more understandable by everyone. After the development of the conceptual model, the practical usability of Innovation Catcher was tested with a case study whose details are provided in the following section.

CHAPTER 6

CASE STUDY ON UTILIZATION OF INNOVATION CATCHER

6.1. General Information about the Study

Construction projects are carried out with the contribution of many actors such as contractors, clients, sub-contractors, suppliers, architectures, and consultants. Among these participants, contractors have a central position in the construction projects, because the ones who have direct communication with the customers and other participants and deliver the project to the customers are the contractors (Sariola, 2018). Contractors start to take part in many different activities, in addition to their traditional duty which is carrying out the construction of the projects (Dikmen et al. 2005). Contractors' direct relationships with both the clients and the project participants allow them to analyze both the need of the clients and capability of suppliers (Larsson as cited in Sariola, 2018). Moreover, contractors are important sources and practitioners of innovative activities (Miozzo & Dewick, 2002). Therefore, they have a significant role in the development of innovation in the construction industry. Because of all these facts, in this study, assessing the innovation performance of contractors was aimed and IC was modified based on the perspective of a contractor. Then the research question to be answered becomes:

How successful is the Innovation Catcher in reflecting the actual innovation performance of contractors?

In the Oslo Manual, innovation activities are distinguished into three types (OECD, 2005). The first type is successful innovation activities, which are successfully implemented in the companies' operations. The second type is ongoing innovation activities that are in progress and not resulted in the implementation, and lastly, abandoned innovation activities, which are stopped before implementation. In this

study, successful innovation activities were investigated. While assessing the successful innovations, the level of radicalness, which is very important for gaining a competitive advantage (Martínez-Román et al. 2017), was taken into consideration.

IPA is a continuous process rather than a one-off affair, and periodic assessment is required for better evaluation (Dulkeith & Schepurek, 2013). In the project-based construction industry, to assess the innovation performance of the construction companies, assessment should be done for a sufficient number of projects in a certain period. Therefore, in this research 5 projects of Company A from the time period of 1985-2016 were investigated. The detailed information about the company is provided in the following section.

6.2. Information about the Company

The case study was carried out with a 50 years old large size company, which is one of the reputable construction companies in Turkey. For the reasons of confidentiality, the company will be mentioned as Company A. The main activity field of Company A is the construction industry. In addition to construction works, Company A has maintained its activities in different industries such as service, manufacturing, tourism, and insurance, both in the national and international market. The company is a member of the Turkish Contractors Association. Company A, whose head office is located in Ankara, is one of the largest contractors in Turkey with approximately 4.500 personnel. As both an entrepreneur and a contractor, Company A has become one of the pioneers in the Turkish housing sector with approximately 100.000 residential units on the total area of 12.000.000 m^2. In addition to the housing projects, Company A realizes infrastructure projects, business center, and shopping mall projects, health and cultural center projects, industrial plant projects and other projects in both national and international market. Most of the projects of Company A are appreciable in terms of their general characteristics and quality.

6.3. Company Interviews

Throughout the research, 5 semi-structured interviews were carried out with an architect from the marketing department of Company A. The interviewee has been working as the project marketing specialist in the company. As a marketing department employee and an architect, the expert has comprehensive knowledge about the projects. It is also worth to note that the expert collected data from the archive and other employees for the questions in the interview form which require more technical information.

During the interviews the semi-structured interview form was followed (see Appendix A) and the expert was asked to evaluate the innovation performance of the projects in terms of the degree of novelty of each successful innovation. The evaluation of degree of novelty was made based on the following scale:

0: No innovation

1: Innovation within the company

2: Innovation in the region/city

3: Innovation in the country

4: Innovation in the world

As can be seen in Appendix A, the semi-structured interview form includes opinion questions as well. In the first part of the opinion questions understanding the company's opinions about the contribution of innovation in gaining competitive advantage was aimed. In the second part, the answers of the questions reflected the company's stated innovation strategy. The interviews also included the questions related to the innovation definition of the company and innovation management practices.

Contents of each interview are summarized in Figure 6.1. The first meeting had the characteristics of a pre-interview. The general information about the research and

expectations from the company were relayed, and the interview process was planned. In the second meeting, first, the interview form was reviewed, and the necessary revisions due to the privacy policy of the company were determined. Then, the company's approach to innovation whose details are presented in Chapter 7 was discussed. Housing projects that will be used in the research were selected, and related archival sources were collected in this meeting. Thus, in addition to interviews, findings were corroborated with newsletters and archival data. In the third meeting, data of Project 1, Project 2 and Project 3 was collected by filling the interview forms. To provide consistency, before starting to fill out the semi-structured interview forms, the definition of innovation presented by OECD (2005) was explained and asked the expert to evaluate the performance within this context. During the interviews, the expert was asked to specify the innovative aspects of the projects for each question in the form. The re-evaluation of Project 1, Project 2 and Project 3 was done in the fourth meeting. The purpose of this step is to clarify unclear information related to the project if there is any. Then, Project 4 and Project 5 were discussed, and data were collected for these projects by filling the interview forms. In the last meeting, after reviewing the Project 4 and Project 5, the usability of the model was tested by interviewing with the expert. The outputs of the interviews are provided in the next chapter.

Table 6.1 *Structure of the Interview Sessions*

Interview Session	**Content of the Interview Session**
Pre-interview	General information about the research
	Process planning
	Expressing the expectations from the company
Interview 1	Preliminary consideration of interview form
	Selection of the projects
	Collection of the archival data sources
	Interview about company's innovation perspective
Interview 2	Interview about Project 1, Project 2 and Project 3
Interview 3	Interview about Project 4 and Project 5
	Re-evaluation of Project 1, Project 2 and Project 3
Interview 4	Re-evaluation of Project 1, Project 2 and Project 3
	Discussion of findings and usability testing

CHAPTER 7

FINDINGS FROM THE CASE STUDY

7.1. Findings about the Company

Company A has many different "firsts" in its history. It draws attention mostly with their housing projects in different living concepts. These new concepts have inevitably accompanied innovations in different areas. However, in terms of some practices and approaches, the expert has described Company A as "conventional." For example, as the expert stated, the company has a more traditional attitude toward new software usage.

In the interviews, consistent with the literature review, the expert stated that the understanding of innovation concept in the industry is very narrow. When the definition and minimum requirements of innovation provided by OECD (2005) were explained, the difference between the understanding of the industry and the actual concept was revealed. The expert has expressed her opinion about the definition and exemplified the current situation as follows:

"*For example, the software is developed somewhere external to us, and we implement this software into our processes. But we do not consider this new software implementation as innovation, but as catching the era. Maybe the problem in the industry is this. As a matter of fact, considering this as innovation is reasonable because it contributes your process to execute more effectively and adds value to your process. "*

The expert also added that although the innovations are actually realized, most of the companies including Company A slur over these innovations unless they attract the customers' attention. During the interviews, the expert has highlighted the existence of intense competition in the construction industry in recent years as:

"*In the past, during the book-building, the sale of the projects was completed to a great extent. Projects were sold due to the brand name of the company. This impact is continuing, but competition has increased a lot. Now, we have to follow certain things. Marketing tools and strategies are intensively being used. Also, considering the purchasing power of the country, the perception of selling by brand name is no longer available."*

The changing competitive environment over time has inevitably affected the companies' sales and marketing strategies. With the rapid developments in technology, different advertising channels and methods are starting to be used. The expert highlighted the importance of marketing strategies frequently during the interviews. The expert explained the effect of increasing competition on the pricing strategies of the company as follows:

"Our company has a certain pricing policy. However, what we have done in the past and today are very different. In the past, by considering the economic condition of the country and the interest rates a definite payment plan was provided. There was sharper discrimination between people who can purchase and who cannot. The ones who cannot purchase in that period were waiting for the next payment plan period. But, today to attract the customers and sell the project, individual payment plans must be prepared for each customer."

Company A associates the innovation to competition and therefore, they generally focus on the cause celebre innovations. Company A is the first in using and manufacturing the tunnel formwork in Turkey which has created a great impression in the country. Introduction of tunnel formwork into the Turkish construction industry helped companies to improve the quality and the flow of the construction process. However, in the interview, the expert emphasized the rareness of process innovations and challenges to catch them in the construction industry as follows:

"*Process innovations may not be noticed, even though they actually realize in the site. Because, most of the time these innovations occur suddenly in the site, and with the*

thought that they have already been introduced by someone else, these innovations are generally overlooked."

which is consistent with the findings from the literature.

When the innovation assessment practices of the company were investigated, it was revealed that the company does not use any method or model to assess innovation performance. But they relate the success of innovations in the project with the success of sales. Therefore, the expert suggested that they have already had a model to assess the sales process so the success of innovations may be deduced from the success of sales. However, although it may provide insight into the innovation performance very roughly, since the sales may be affected by many factors in order to assess the actual performance a separate model is needed.

7.2. Findings from the Sample Projects

In this part the finding about the sample projects and innovation performance of individual projects and IC profiles of these projects are presented. Based on the related archival documents and the knowledge of the expert about the projects, each qustion in the 'Innovation' part in the interview form (see Appendix A) was answered and a score was given based on the novelty degree of innovations. Then these scores were entered in an Excel sheet and the IC profiles were drawn in Excel. In Appendix B, the questions related to each dimension was shaded with green. Since last questions under each main innovation types ask the other innovations in related main innovation type, these questions are not shaded. Because, the contribution of these qustions to the dimensions depends on the innovation itself and may show differences in different projects. Then the innovation performance of the projects in each dimension was calculated as the average of the scores given in each question in the related dimension.

In the following sections the deatils about the sample projects and the IPA results are presented.

7.2.1. Project 1

Project 1 was constructed in the period of 1985-2004. The expert described Project 1 as one of the symbol projects of the company. The size of the project (1571 housing units and utilities such as schools, post office, sports facilities, shopping center, treatment facility, plant house, etc.) had a significant effect on the innovation performance of the company. The expert stated that Project 1 was one of the most innovative projects of its time and the latest technologies were used in the construction of Project 1. Since its completion period has covered almost two decades, during the construction process of Project 1, many new or improved approaches and techniques were used.

An interesting point in this project is that generally projects are called as the name of the region where they are constructed, but uncommonly this project gave its name to the region in Ankara. Being the first housing estate in the region may be influential in this issue.

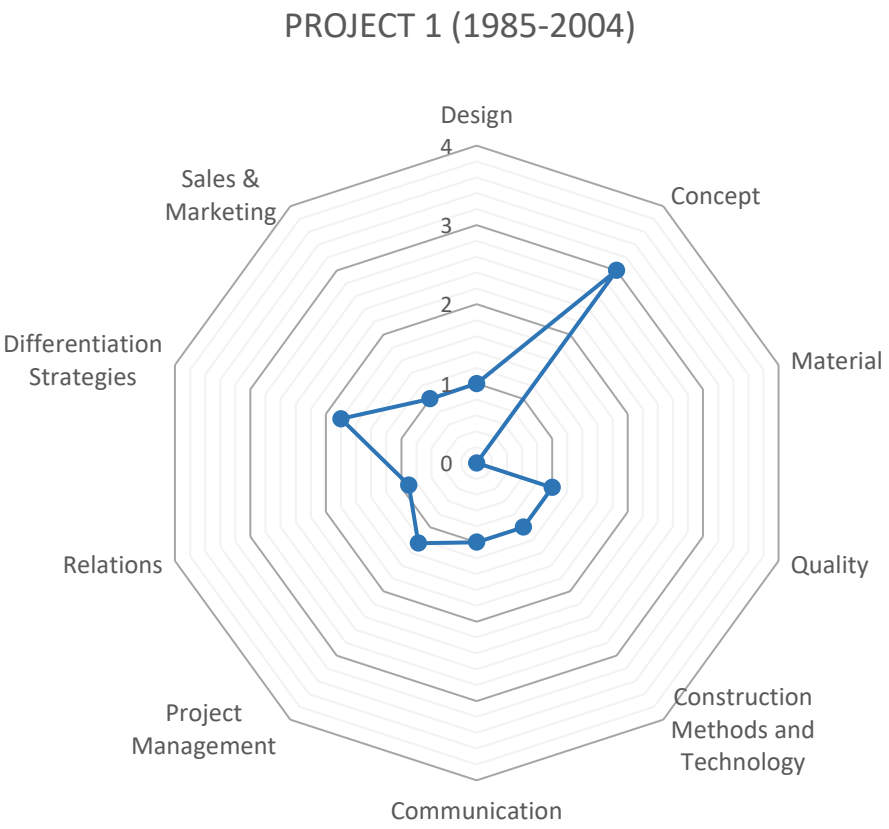

Figure 7.1. Innovation Catcher Profile of Project 1

The most conspicuous innovations in Project 1 were realized in the dimension of the living concept it offered and the differentiation strategy it followed (see Innovation Catcher profile in Figure 7.1) because innovations in both dimensions were the first for the country. In terms of living concept, Project 1 is the first contemporary housing estate in Turkey. In other words, with this project Company A has brought a new living concept to the country. With the new concept, different customer groups were served in this project. Although elementary families form the general customer profile of Company A, in Project 1, unmarried people and extended families were among the target customer groups. Therefore, apartments with different size and number of rooms were built within the scope of this project. Also, in one of the archival document provided by the company, the innovative design of both housing units and the

landscape that emerged as a result of changing customer groups and their needs was highlighted.

As a differentiation strategy, Company A is the first in bringing the "service after delivery" concept in the country with this project. Since the construction of Project 1, Company A has carried out their services after delivery of the houses with their sub-company. Company A has maintained communication with the customers through the sub-company which provides maintenance and repair services after the delivery of the project. According to the expert, "service after delivery" concept is among the company's most important and most prevalent innovations. In terms of differentiation strategies, this innovation has brought significant competitive advantage to Company A, since this was first in the country at that time. As can be seen in the Innovation Catcher profile of Project 1, these innovations contributed to increasing the company's innovation performance along differentiation strategy and concept dimensions.

The expert also noted that although some concepts and technologies such as sustainability, green building approaches, GPS or simulation were not common in the country at the construction period of Project 1, it was far beyond its age as concept and technology. For example, although it was not named as "sustainability," according to the expert extensive planting works and large green fields in Project 1 may be considered as another point of view for environmental sustainability at that time. The archival records of the company support this view and introduce Project 1 as "the pioneer in protecting the nature that was destructed as a result of increasing construction works and in redressing the balance between nature and the built environment." Also, the expert added that maintenance and repair services offered after the delivery of the project might be considered as the effort to create a sustainability concept at that time.

As can be seen in Figure 7.1, innovations were realized in Project 1 in all dimensions except material dimension and innovation performance in these dimensions are almost the same. According to the expert, the size and concept of the project necessitated the innovations in other dimensions at least at the company level.

7.2.2. Project 2

The construction of Project 2, which was a contracting project with a government entity, started in 1993 and finished in 1996. This project is the first smart housing project where the application of building automation was first used in Turkey. In Project 2, microprocessors were used in the project for fire and burglar alarm and for enabling water and temperature control. An effort to decrease the energy consumption which may be the evidence for the introduction of sustainability concept draws attention in Project 2. The building automation used in the project has enabled households to control the internal air temperature. Also, new techniques and materials which do not include hazardous chemicals were used for decreasing the heat loss. As is the case with Project 1, in Project 2, there was an effort to ensure sustainability, although it was not a common concept in Turkey at that time.

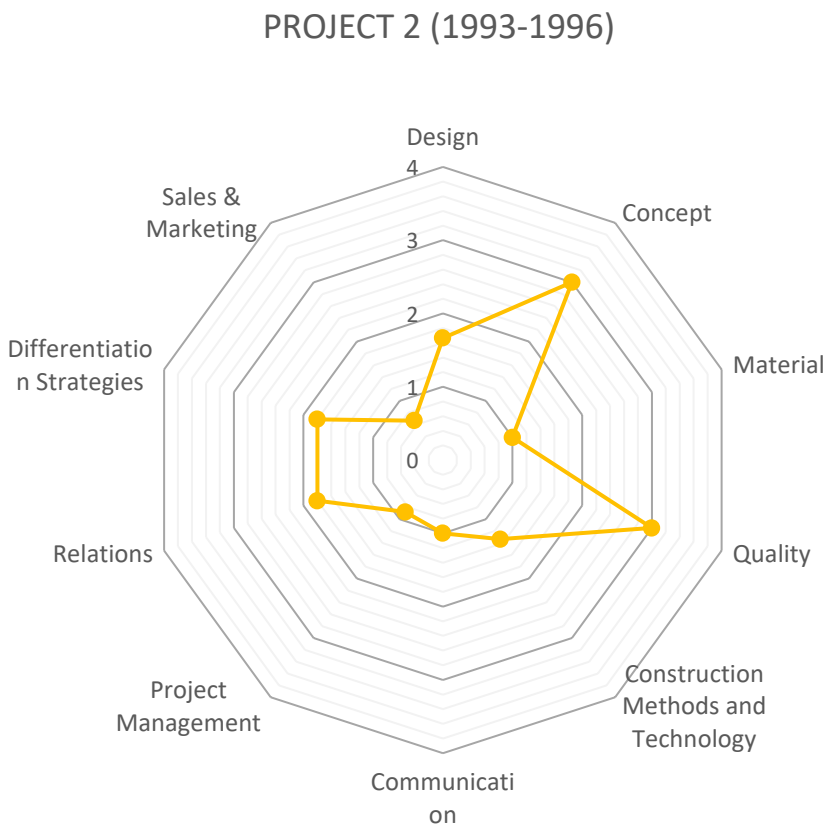

Figure 7.2. Innovation Catcher Profile of Project 2

The landscape design of the project is another conspicuous innovation in Project 2. Project 2 was introduced as the first housing estate in Turkey that combines daily life and art. In addition to large green fields and planting works, unique sculptures were used in this project and integrating the architecture of the buildings and landscape design was aimed with this application. The expert drew attention to the innovative relationship established with the universities in the landscape design process of the project. Although it was not a direct relationship with the university, the company worked with sculptures and artists from different universities for the first time in its history.

As it can be seen in the Innovation Catcher profile, Company A broke through in terms of quality of the work with Project 2. In archival documents, the quality ensured in Project 2 was highlighted as:

"Project 2 is the turning point for the company in terms of the quality. In the project, superior quality in materials, subcontractor selection and solutions of the details were ensured. A product which is above the country's standards were produced."

Since building automation which was a new technology for the country was used in Project 2, as the expert highlighted, using new approaches in project management and establishing innovative relations with different parties were inevitable. Therefore, in many management practices and established relationships innovations at least at the company level were realized.

Project 2 was the first project in the country that was carried out by the aforementioned government entity in terms of addressing the high-income group as a target customer group. It is also worth to mention that Project 2 has attracted the constant attention of media during its construction that found buyers with unprecedented prices in the housing sector, and had been subjected to discussions even at TBMM (Grand National Assembly of Turkey) due to high prices.

In an archival document provided by the company, the security problem in the region was mentioned, and the burglar alarm, security services, etc. served in Project 2 was introduced as the solution for this problem. As the expert stated, with these properties of the project the security need of the households was addressed which helped to attract the customers' attention. It is also worth to note that, Project 2 is still mentioned as one of the best housing projects in the region even today.

7.2.3. Project 3

Project 3 which was constructed in the period of 1994-1997 is the first summer house project of Company A. Project 3 composes of 118 housing units and has the feature

of being the first housing project of the company in the Mediterranean coast. Therefore, innovations along different dimensions are expected due to the introduction of a new concept and entering the new geographic market. In common with Project 2, sculptures and artists from different universities involved in the project to create a town concept. As a part of the concept, an eco-park was built. Again, with the construction of an eco-park and large orange gardens, the project serves environmental sustainability.

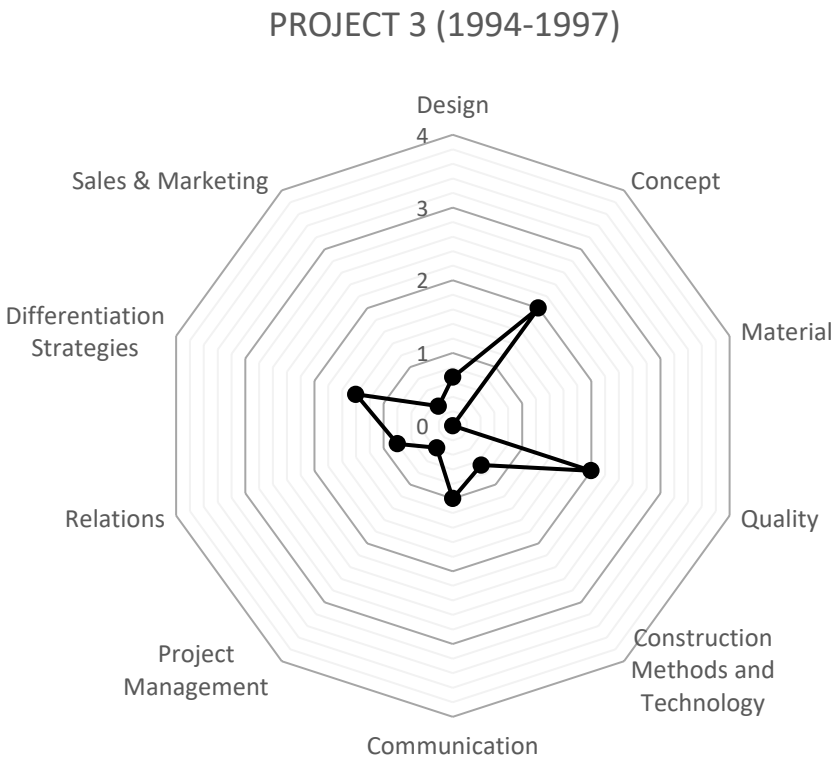

Figure 7.3. Innovation Catcher Profile of Project 3

The target customer group in Project 3 was the families with children. According to the expert, children were in the main focus of the project with the activities proposed within the concept. Within the scope of service after delivery concept, in addition to garden care and security services, Company A has offered maintenance and

accommodation services for the boats and cleaning services before the arrival of households. The expert described Project 3 as:

"Project 3 is for the people who are torn in between two choices; purchasing a summer house or going to a holiday village. Because it offers a summer house with the comfort of a holiday village. The activities offered especially for children are a complete substitute of that are in a holiday village."

Although the breakthrough innovations were not realized in Project 3, with its different concept and the quality of the workmanship, it had repercussions in the region.

7.2.4. Project 4

Project 4 is a mega mixed-use project which consists of a theme park, plaza and housing space located in İstanbul. Project 4 is a partnership project of Company A and two other construction companies. The construction of the whole project was realized in 2011-2015. The construction of the housing project part with 3600 housing units on 333 000 m^2 area was completed in 2 years. The new advanced project management approaches and construction techniques used in the project resulted in such a fast construction process. As the expert highlighted, especially when the size of the project and the construction speed were considered, it was revealed that advanced scheduling practices were applied in the project.

Project 4 was awarded International Property Awards and European Property Awards in different categories and was introduced as the symbol project of Turkey. Project 4 is one of the largest projects of Europe and arouse interests of many international organizations. The expert stated that financial institutions from two different countries gave an offer for Project 4 to get involved in the project. Also, the expert added that a committee from South Africa came for observing Project 4 for benchmarking the projects in their country.

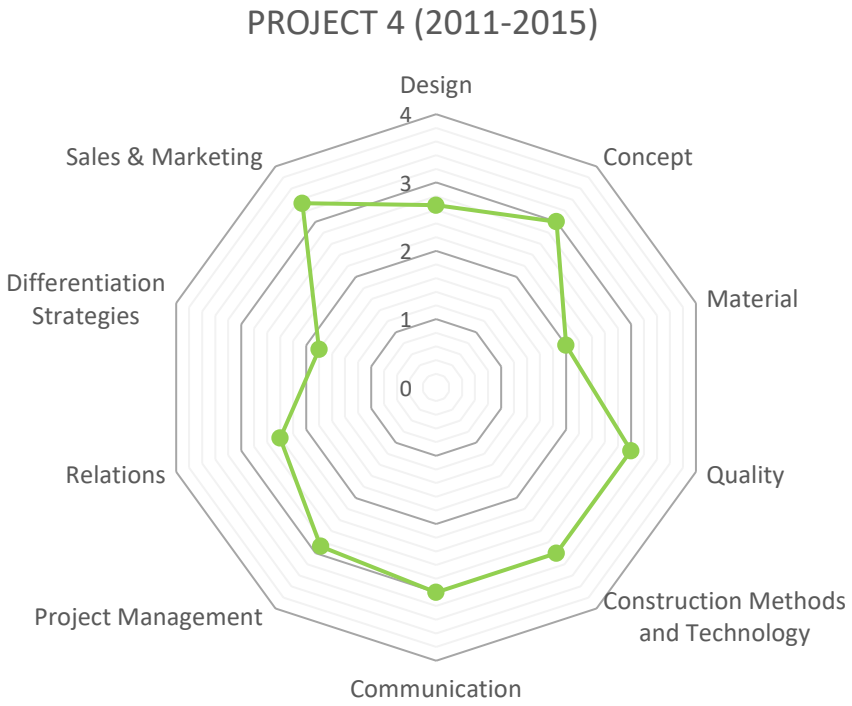

Figure 7.4. Innovation Catcher Profile of Project 4

As it can be seen in the Innovation Catcher profile above, Project 4 was highly innovative in sales and marketing practices. In Project 4, the interactive advertisement was used in the introduction of the project for the first time in the world. The showroom of Project 4 was also awarded "Highly Commended" in the International Property Awards "Landscape Design for Commercial Buildings" category. According to the expert, all by itself constructing such a remarkable building for the showroom was an innovative approach in marketing. Additionally, a fair in Cannes was attended to introduce Project 4 in the international arena. The expert explained the effects of differentiated marketing strategies in the sales of the project as follows:

"Project 4 is far beyond the existing marketing techniques. Both the construction and sales rates of Project 4 make us glad."

7.2.5. Project 5

The construction of Project 5 was realized in 2014-2016. Project 5 is located in the center of the city where most of the embassies are located. The expert has described the project as an A+ project whose target customer group is especially the embassy employees due to the location of the project. Company A has different projects near the location of Project 5. In these projects, families were addressed so far in the region. However, as the expert stated, due to the concept of the project, Project 5 is not suitable for families with children which is the main customer group of Company A. Therefore, in terms of the customer segment, Company A has addressed a different focus group in its history. As can be seen in the Innovation Catcher profile of Project 5 (see Figure 7.5), change in the main focus group resulted in changes in different dimensions like design and concept of the project. It is worth to note that Project 5 was awarded the best residential high-rise architecture in European Property Awards.

On the one hand, the modern and innovative design of Project 5 takes the attention when compared with the more simpler design and external view of the surrounding buildings. On the other hand, since some found the height and external appearance of the building as discrepant from the general view of the region, Project 5 subjected to discussions. Nevertheless, it is evident that Project 5 has innovative internal and external design and succeeds in addressing the target customers groups.

As the expert highlighted, when the customer segment is changed, the marketing techniques also need to be changed. Company A commonly organizes events like barbecue parties and picnics to introduce their projects. However, different from all the other projects, the company organized an exclusive event for Project 5. Company A converted one of the flats into an art exhibition and placed paintings in the flat. Then a reception was given and by utilizing the technology 3D presentation of the project was made. According to the expert, with this event, the target customer group was attracted as the company aims.

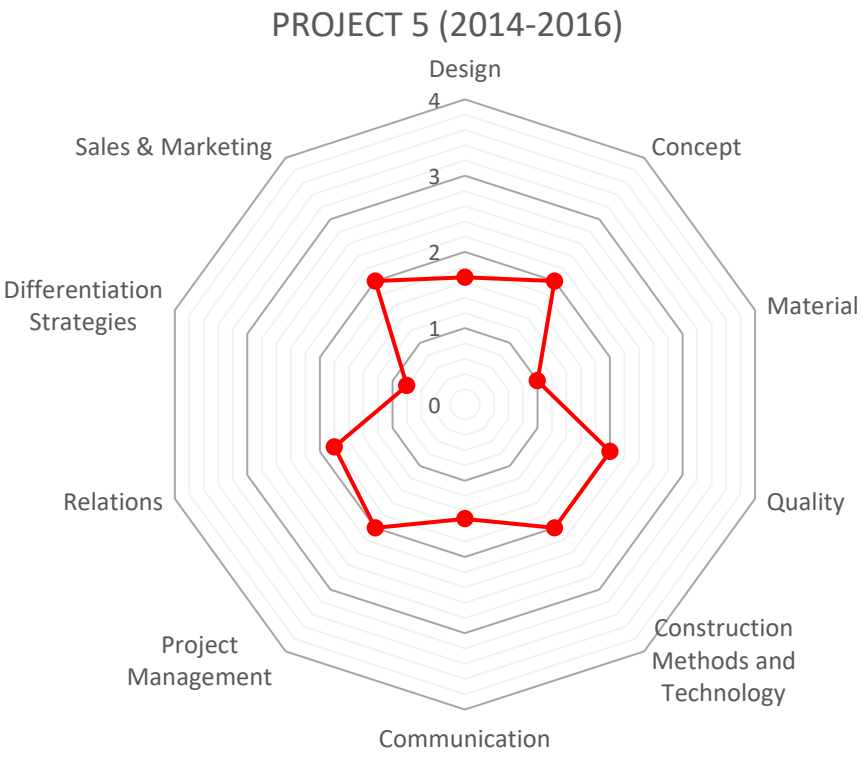

Figure 7.5. Innovation Catcher Profile of Project 5

In Project 5, the effect of the technological developments was observed clearly. As the expert stated, Project 5 stands out amongst other buildings in the region in terms of the technology used both in the design and construction phases. In the design process of Project 5, simulations, computational fluid dynamics analysis (CFD), wind analysis and pedestrian comfort analysis were made. Company A used the glass fiber reinforced concrete (GFRC) which reduces the carbon emission for the first time in Project 5 which shows that the environmental effects and sustainability issues were concerned in the project.

CHAPTER 8

DISCUSSION OF INTERVIEW RESULTS

In this chapter, the results of the usability testing interview are presented. As a result of the evaluation of findings, the expert discussed the outputs, possible usage areas, and benefits of Innovation Catcher and made recommendations for the improvement of the proposed model. Also, the consistency of the IC profiles of the sample projects with the reality was discussed in the interview. The results are presented below under 3 headings.

8.1. Evaluation of IC Profiles of Sample Projects

In the interview, the expert evaluated and commented on the consistency of the IC profiles of sample projects and overall performance. After assessing the project level innovation performance, the overall innovation performance of Company A was evaluated by integrating the IC profiles of 5 projects. When the individual IC profiles of the projects are put on top of each other, the resulting profile will reflect the general tendency of the company in the evaluation period. Selected projects have the feature of reflecting the overall innovation performance of the company in the period of 1985-2016.

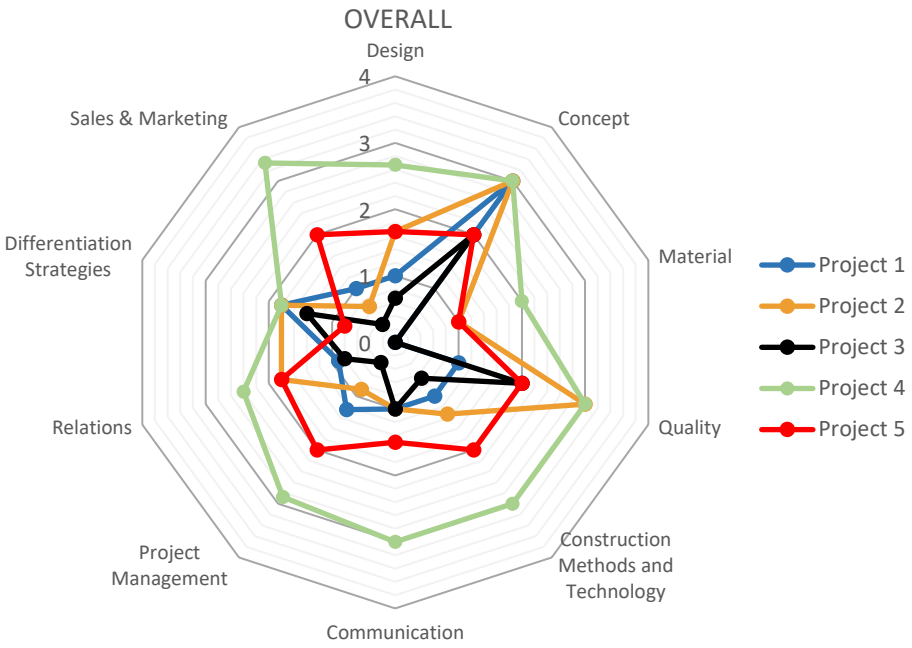

Figure 8.1. Overall Company Performance in 1985-2016

When the overall innovation performance of Company A is evaluated, it is seen that Company A is least innovative in using new materials in their projects. This result is consistent with the stated innovation strategy of the company. The expert stated that;

"The materials used in the project are important. But they have been starting to lose their significance in today's highly competitive environment. By using the available materials, you can still meet the customer needs with a completely new concept and create remarkable living areas. Rather than the material, the quality of workmanship and its usage methods are much more important."

As consistent with the expert's statement, Company A has a tendency to produce housing projects with the new living concepts in differentiated quality. The expert emphasized the importance of the quality of workmanship and product for the company as follows:

"The projects of Company A can be easily distinguished from other projects in Ankara. The quality of production and usage of the material or the production style may be distinctive features of our projects."

Innovations realized in the construction projects may help companies to create a brand image and to increase the attractiveness of their projects. As can be understood from the expert's statement above, Company A has created an image in the housing sector with its distinctive quality of projects and different living concepts it offered by innovating along these dimensions.

8.2. Possible Usage Areas of Innovation Catcher

In the interview, the expert discussed the possible usage fields where the construction companies may benefit from IC. These fields can be grouped under 4 main categories which are communication, project-based decision-making process, documentation, and long-term company-based strategy formulation.

In the construction projects, creating a common language between and within parties is essential both for ensuring effective communication and appropriate project management. It is also applicable for innovation implementation and management processes. In IC, the visualization of innovation performance may help construction companies to create a common language. The expert supported this statement and noted that the IC profiles help companies to develop a shared understanding of innovation concept and innovation performance assessment method. However, the expert added that the IC profiles would not affect direct communication and relationship with the project stakeholders.

The possible innovation fields in the housing sector determined in the IC guide companies and help them to create strategies to realize the predetermined project objectives. Based on the expert's example, let's consider a company who needs to improve its cash flow. If the company starts off a housing project to complete the construction in 1 year, then this company may benefit from the IC to formulate its strategies to reach its goal. By innovating in different dimensions that IC provides

such as construction methods, communication methods with project parties or sales and marketing strategies, the construction and sale process may be accelerated. In this regard, IC helps the company to broaden its view and to work on multiple dimensions to reach its targets.

According to the expert, IC profiles may be used in the documentation process as an effective visualization tool for summarizing the successful innovation activities in the project. Such documents can be used for retrospective researches or in the decision-making process. According to the expert, these documents and researches may help the company to develop more comprehensive and company-based long-term strategies. For example, by considering the overall innovation performance of Company A in a 30 years period (see Figure 8.1.), it can be said that Company A has brought innovative approaches most in quality and concept dimensions to the housing sector. However, whether Company A will continue to focus on these dimensions as it was in the last 30 years or change their innovation focus to other dimensions in the next 10 years is a critical decision that the company should make. As the expert supported, by investigating the IC profiles of past projects and evaluating them with the success of projects in their life cycles, the company can effectively formulate the long-term innovation strategies for the future.

The experiences of the construction companies in previous projects affect future decisions and actions. IC profiles reflect the performance of companies in terms of successful innovations, i.e., innovations that are created, implemented and diffused. As the expert stated, the success of innovations in the project can be associated with the success in sales and therefore in the decision-making process of the future projects decision makers can benefit from the IC profiles of similar projects. In other words, the IC profile of a particular housing project can be used to create a base for similar projects in the future. The expert explained the possible role of IC profiles in the decision-making process and exemplified this as follows;

"Drawing IC profiles may affect the future decisions and strategies for similar projects. For example, Company A or any other construction firm which is located in Ankara may use the IC profile of Project 3 as a reference when they decide to build a summer house project."

Similarly, the IC profile of Project 4 whose rate of sales and construction are considerably fast can be used for creating a benchmark for similar projects. Innovative applications or approaches which contributed to the success of Project 4 can be followed in similar large scale projects. In other words, as the expert stated, the results obtained from the IC profile of a certain project may be used as a starting point for similar projects.

8.3. Recommendations of the Expert

During the interviews, the expert emphasized the effects of the size and the construction time of the projects on innovation performance of the housing projects. According to the expert, the innovation performance of the housing projects may differ based on the size of the project. For example, after recognizing the region and procedures, constructing a housing project with 200 units becomes a regular job for a company. In large scale projects, however, with the inclusion of a large number of parties and complex structures, the need for improving the process may increase in various dimensions. According to the expert, the dimensions of the IC may change according to the size of the project because some of the dimensions that are already available in the IC may not be applicable in small projects. For example, as the expert discussed, although Project 5 is a distinctive project and won many different awards, due to its scale its innovation performance is low when compared with Project 4. For this reason, the expert suggested changing the shape of the IC according to the size of the projects. However, since the primary objective of IC is assessing the innovation performance at the project level, i.e., the project performance is evaluated in itself, the effect of the size of the project is not critical in this model. Also, the expert highlighted

that the innovative capacity of the projects may not always be proportional to the scale of the projects.

In this research, IC was used for assessing the innovation performance of 5 sample projects that cover the period from 1984 to today. During this period, important developments occurred in technology which significantly affects the construction process, and approaches and hence the innovations in the construction industry. For example, Project 1 and Project 4 are similar in size, and both projects are highly assertive in terms of the innovativeness in their times. However, after drawing the IC profiles of the sample projects, it was noticed that the IC profile of Project 1 covers considerably less area (i.e., it has lower innovation performance) when compared with the IC profile of Project 4. The reason for this unexpected difference was that the assessment of the innovation performance in each dimension was done based on today's concepts and technologies like sustainability, virtual reality, and smart technologies. However, some of these concepts and technologies were not available in the country 30-40 years ago when Project 1 was being constructed. According to the expert, the time factor affected the IC profile of Project 1, and therefore, the current IC profile does not reflect the actual innovation performance of Project 1. To assess correctly the innovation performance of the projects that belong to different periods, the expert suggested classifying the projects based on their construction times. So that, the innovation performance of these projects can be assessed according to their time and available concepts. As the expert stated, depending on the time, dimensions of IC may show differences when compared with its proposed form.

Lastly, as the expert highlighted all of the sample projects were completed projects, and some of the required data was collected as a result of archival research which took considerable time. According to the expert, both for time-saving and the accuracy of data, IC should be applied during the construction phase. So that, data can be collected and stored simultaneously and accurately.

CHAPTER 9

CONCLUSION

9.1. Major Findings

The requirement of the innovation performance assessment (IPA) of construction projects and appropriate tool for assessment are frequently discussed by the scholars as presented in the previous chapters. In the light of the literature review, two main reasons why companies should assess the performance of innovation activities can be listed as follows:

- Innovations require the investment of time and money. For this reason, as in the other investments, the performance of innovation activities should be assessed.
- IPA enables companies to understand their current situations. It makes possible to interpret the effect of their innovation activities on the sales or their financial conditions.

Construction industry differs from other industries with its characteristics. Therefore, a special interest is required to investigate the innovation concept in the construction industry. As a result of an in-depth literature review on innovation in the construction industry, the main gaps in the literature are determined as:

- lack of broad view of innovation in the construction industry,
- lack of IPA framework that can be easily used in practice,
- lack of a framework that assesses the innovation performance at the project level.

In this research, in the light of the needs listed above Innovation Catcher was designed for specific usage in the housing sector. While the dimensions of IC encourage

companies to broaden their innovation perspective, being designed for assessing the successful innovations make IC a practical framework for industry use by removing the necessity of using metrics. Also, IC enables to visualize the results of IPA which help companies to store and present the results effectively.

The usability of the IC was tested by carrying out multiple interviews with an expert from the marketing department of one of the largest and most well-known contractors in Turkey. The major findings obtained from the interviews are consistent with the literature review and as follows:

- Definition of innovation in the construction industry is very narrow. Only the breakthrough innovations are considered as "innovation."
- IPA is not performed in the construction industry.
- Innovations that are realized spontaneously in the construction site are not able to be caught and recognized as innovation when the innovations are investigated at the company or industry level.

To test the usability of IC, IC was applied in 5 sample projects which are in different size and scopes and from different geographies. Then in the last interview session, the expert discussed the results and possible usage areas of IC. As a result, the major benefits and usage areas can be listed as follows:

- IC may help companies and project participants to create a common understanding of the innovation concept and its assessment.
- IC profiles may create a strategic basis for similar housing projects in the future and may be used in project-level decision-making processes.
- IC profiles can be used in the documentation process as effective visual support or summary.
- By investigating the IC profiles of multiple projects the general innovation tendency or strategy of a construction company can be understood, and long-term strategic decisions can be made at the company level.

As a result of the investigation of IC profiles, the expert agreed that the results are consistent with the reality and IC profiles are capable of reflecting the real innovation performance of the sample projects to a large extent. However, the expert also discussed the inconsistencies and made recommendations based on the application process and the results. According to the expert, underperformance of earlier projects, especially Project 1, resulted from the inconsistency of the project time and the assessment time. Therefore, the expert suggested classifying the projects based on their time and assessing their innovation performances accordingly. This recommendation was agreed and noted as a major improvement for future studies.

9.2. Limitations of the Research

There are some limitations to the study. The major limitation of this study is that the study was carried out as a case study. In the research, 5 sample projects of one company were studied. Therefore, the results can not be generalized. In this sense, further studies are required.

Secondly, in this research, the data of 5 different projects in 30 years period was used. Due to the inefficient project information storage methods used in the past, some assumptions were made while answering the questions in the interview form, especially for the earlier projects. Although it did not affect the usability testing of the framework and the research question, it affected the accuracy of IC profiles.

9.3. Recommendations for Future Studies

Innovation Catcher can be improved further in the light of the recommendations that the expert made and the results we obtained. The recommended improvements and additional studies about Innovation Catcher are as follows:

- This study was carried out as a case study by working with a company. This case study has enabled an in-depth research and investigation about the main research question and provided a basis for future researches. However, for

testing the applicability of IC further, more companies should be involved in the study.

- The construction phase of all the sample projects and the sales of 3 sample projects used in this study were completed. Therefore, the IC profiles of these projects were drawn based on the archival data and some assumptions, and the possible usage fields and benefits were discussed accordingly. However, IC should be tested in on-going projects as well. So that, the practical use of IC during the construction phase when the innovation data can be collected simultaneously can be tested.
- Technological developments and dominant concepts can affect and change the shape of the IC profile of a project. In this study, the interview form was prepared based on today's technology and concepts which negatively affected the IPA of earlier projects. To reflect the innovation performance of projects from different times accurately, questions in the interview form should be changed or updated according to the conditions in the project time. One alternative to achieve this, projects can be classified into the appropriate time periods, and IC profiles can be shaped accordingly. So that, the assessment can be done based on the valid criteria.
- In this research, IC was used to assess the innovation performance of the housing projects. Similar studies can be done for different types of the projects (infrastructure projects, industrial building projects etc.) by making necessary modifications on the dimensions of IC. Also, the evaluation can be made in different perspectives (marketing, business development, strategic planning, bidding etc.).

REFERENCES

A&T Bank. (2016). Housing sector in Turkey: the importance of the housing sector in Turkish economy. Retrieved from https://www.atbank.com.tr/documents/HOUSING%20SECTOR%20IN%20TURKEY.PDF

Amabile, T. M. (1997). Motivating creativity in organizations: on doing what you love and loving what you do. California Management Review, 40(1), pp. 39-58. DOI: 10.2307/41165921

Andrew, J. P., Haanaes, K., Michael, D. C., Sirkin, H. L. & Taylor, A. (2009). Measuring innovation 2009: the need for action. Boston Consultancy Group: Innovation, 112(3), pp. 1-23. Retrieved from http://209.83.147.85/publications/files/BCG_Measuring_Innovation_Apr_2009.pdf

Barata, J. M. & Fontainha, E. (2017). Determinants of innovation in European construction firms. Technological and Economic Development of Economy, 23(6), pp. 915-936. DOI: 10.3846/20294913.2016.1212437.

Barrett, P., Sexton, M., & Lee, A. (2008). Innovation in small construction firms. New York: Taylor & Francis.

Barrett, P., Sexton, M., & Lee, A. (2008). Innovation in Small Construction Firms (1st ed.). London, UK: Taylor & Francis.

Becker, S. W., & Whisler, T. L. (1967). The Innovative Organization: A Selective View of Current Theory and Research. The Journal of Business, 40(4), pp. 462-469. Retrieved from http://www.jstor.org/

Blayse, A. M., & Manley, K. (2004). Key influences on construction innovation. Construction Innovation, 4(3), pp. 143-154. DOI: 10.1108/14714170410815060

Boer, H., & During, W. E. (2001). Innovation, what innovation? A comparison between product, process and organizational innovation. International Journal of Technology Management, 22(1/2/3), pp. 83. Retrieved from https://www.inderscienceonline.com/

Bygballe, L. E. & Ingemansson, M. (2014). The logic of innovation in construction. Industrial Marketing Management, 43(3), pp. 512-524. DOI: 10.1016/j.indmarman.2013.12.019

Damanpour, F., & Wischnevsky, J. D. (2006). Research on innovation in organizations: Distinguishing innovation-generating from innovation-adopting organizations. Journal of Engineering and Technology Management, 23(4), pp. 269-291. DOI: 10.1016/j.jengtecman.2006.08.002

Dikmen, I., Birgonul, M. T. & Artuk, S. U. (2005). Integrated framework to investigate value innovations. Journal of Management in Engineering, 21(2), pp. 81-90. DOI: 10.1061/(ASCE)0742-597X(2005)21:2(81)

Dubois, A., & Gadde, L. E. (2002). The construction industry as a loosely coupled system: Implications for productivity and innovation. Construction Management and Economics, 20(7), pp. 621-632. DOI: 10.1080/01446190210163543

Dulkeith, E. & Schepurek, S. (2013). Innovation Performance Measurement: Assessing and driving the innovation performance of companies. ISPIM Conference. Helsinki. DOI: 10.1007/978-3-642-10823-5_18

Eaton, D. (2001). A temporal typology for innovation within the construction industry. Construction Innovation, 1(3), pp. 165-179. DOI: 10.1108/14714170110814587

Fagerberg, J. (2009). Innovation: A guide to the literature. The Oxford Handbook of Innnovation, (May 2018), 1-29. DOI: 10.1093/oxfordhb/9780199286805.003.0001

Frenkel, A., Maital, S., Leck, E., & Israel, E. (2015). Demand-driven innovation: an integrative systems-based review of the literature. International Journal of Innovation and Technology Management, 12(2), 1550008. DOI: 10.1142/S021987701550008X

Gamal, D., Salah, T., & Elrayyes, N. (2011). How to measure organization innovativeness? Technology Innovation and Entrepreneurship Center, pp. 1-35. Retrieved from http://tiec.com.eg/backend/Reports/MeasuringOrganizationInnovativeness.pdf

Gambatese, J. A. & Hallowell, M. (2011) Enabling and measuring innovation in the construction industry. Construction Management and Economics, 29(6), pp. 553-567, DOI: 10.1080/01446193.2011.570357

Gann, D. M., Wang, Y., & Hawkins, R. (1998). Do regulations encourage innovation? The case of energy efficiency in housing. Building Research and Information, 26(5), pp. 280-296. DOI: 10.1080/096132198369760

Gann, D. M. & Salter, A. J. (2000). Innovation in project-based, service-enhanced firms: the construction of complex products and systems. Research Policy, 29(7), pp. 955-972. DOI: 10.1016/S0048-7333(00)00114-1

Ghaben, R. & Jaaron, A. A. M. (2015). Assessing innovation practices in project management: the case of Palestinian construction projects. International Journal of Innovation and Scientific Research, 17(2), pp. 451-465. DOI: 10.1111/j.1462-2920.2004.00707.x

Green, S. D. & Sergeeva, N. (2018). Value creation in projects: towards a narrative perspective. International Journal of Project Management. DOI: 10.1016/j.ijproman.2018.12.004

Gunday, G., Ulusoy, G., Kilic, K., & Alpkan, L. (2011). Effects of innovation types on firm performance. Journal of Production Economics, 133(2), pp. 662–676. DOI: 10.1016/j.ijpe.2011.05.014

Hao, J. X., van Ark, B., & Özyıldırım, A. (2017). Signposts of innovation: a review of innovation metrics (Working paper no 17-01). Retrieved from https://www.conference-board.org/pdf_free/workingpapers/EPWP1701.pdf

Hansen, M. T. & Birkinshaw, J. (2007). The innovation value chain. Harvard Business Review, 85(6), pp. 120-142. Retrieved from https://hbr.org/2007/06/the-innovation-value-chain

Ilter, A. T. (2009). A methodological framework for the assessment of Turkish contractor firms' innovativeness, presented at RICS COBRA Research Conference, London, 2009.

Kamal, E. M., Yusof, N., & Iranmanesh, M. (2016). Innovation creation, innovation adoption, and firm characteristics in the construction industry. Journal of Science and Technology Policy Management, 7 (1), pp. 43-57. DOI: 10.1108/ JSTPM-03-2015-0011

Keeley, L., Walters, H., Pikkel, R., & Quinn, B. (2013). Ten Types of Innovation: The Discipline of Building Breakthroughs (1st ed.). New Jersey, USA: John Wiley & Sons.

Kline, S. J., & Rosenberg, N. (1986). An overview of innovation. European Journal of Innovation Management, 38, pp. 275–305. DOI: 10.1108/14601069810368485

Kulatunga, K. J., Amaratunga, R. D. G., & Haigh, R. (2006). Construction innovation: a literature review on current research. Paper presented at Conference in the Built and Human Environment, Delft University of Technology and TNO, Delft University, Netherlands. Retrieved from http://usir.salford.ac.uk/.

Loosemore, M. (2015). Construction innovation: fifth generation perspective. Journal of Management in Engineering, 31(6). DOI: 10.1061/(ASCE)ME.1943-5479.0000368.

Manuylenko, V. V., Mishchenko, A. A., Bigday, O. B., Putrenok, Y. L. & Savtsova, A. V. (2015). International Journal of Economics and Financial Issues, 5(4), pp. 1029-1037. ISSN: 2146-4138

Martínez-Román, J. A., Tamayo, J. A. & Gamero, J. (2017). Innovativeness and its influence on growth and market extension in construction firms in the Andalusian region. Journal of Engineering and Technology Management, 43, pp. 19-33. DOI: 10.1016/j.jengtecman.2016.11.002

Miozzo, M., & Dewick, P. (2002). Building competitive advantage: innovation and corporate governance in European construction. Research Policy, 31(6), pp. 989-1008. DOI: 10.1016/S0048-7333(01)00173-1

Morris, L. (2008). Innovation metrics: the innovation process and how to measure it. [White paper]. Retrieved from https://www.innovationlabs.com/publications/innovation-metrics/

Motawa, I. A., Price, A. D. F., & Sher, W. (1999). Scenario planning for implementing construction innovation. London: Cobra (RICS). Retrieved from https://www.researchgate.net/

Murphy, M. E., Perera, S., & Heaney, G. (2015). Innovation management model: a tool for sustained implementation of product innovation into construction projects. Construction Management and Economics, 33(3), pp. 209-232. DOI: 10.1080/01446193.2015.1031684

Nam, C. H. & Tatum, C. B. (1997). Leaders and champions for construction innovation. Construction Management & Economics, 15(3), pp. 259-270. DOI: 10.1080/014461997372999

OECD/Eurostat. (1997). Oslo Manual: Proposed guidelines for collecting and interpreting technological innovation data. DOI: 10.1787/9789264192263-en

OECD. (2005). Oslo Manual: Guidelines for collecting and interpreting innovation data. Retrieved from https://www.oecd-ilibrary.org/

Ozorhon, B. (2013). Analysis of construction innovation process at project level. Journal of Management in Engineering, 29(4). DOI: 10.1061/(ASCE)ME.1943-5479.0000157.

Ozorhon, B., Oral, K. & Demirkesen S. (2015). Investigating the components of innovation in construction projects. Journal of Construction Engineering and Management, 32(3). DOI: 10.1061/ (ASCE)ME.1943-5479.0000419.

Ozorhon, B. & Oral, K. (2017). Drivers of innovation in construction projects. Journal of Construction Engineering and Management, 143(4). DOI: 10.1061/(ASCE)CO.1943-7862.0001234.

Pérez-Luño, A., Cabrera, R. V., & Wiklund, J. (2007). Innovation and imitation as sources of sustainable competitive advantage. The Journal of the Iberoamerican Academy of Management, 5(2), pp. 71-82. DOI: 10.2753/JMR1536-5433050201

Pries, F. & Janszen, F. (1995). Innovation in the construction industry: the dominant role of the environment. Construction Management and Economics, 13(1), pp. 43-51. DOI: 10.1080/01446199500000006

Ravichandran, T. (2000). Swiftness and intensity of administrative innovation adoption: an empirical study of TQM in information systems. Decision Sciences, 31(3), pp. 691-724. DOI: 10.1111/j.1540-5915.2000.tb00939.x

Rose, S., Shipp, S., Lal, B., & Stone, A. (2009). Frameworks for measuring innovation: initial approaches (Working Paper No: 6). Athena Alliance, Washington.

Rutten, M. E. J., Dorée, A. G., & Halman, J. I. M. (20 09). Innovation and inter-organizational cooperation: a synthesis of literature. Construction Innovation, 9(3), pp.285-297. DOI: 10.1108/14714170910973501

Sariola, R. (2018). Utilizing the innovation potential of suppliers in construction projects. Construction Innovation, 18(2). DOI: 10.1108/CI-06-2017-0050.

Sawhney, M., Wolcott, R. C., & Arroniz, I. (2006). The 12 different ways for companies to innovate. MIT Sloan Management Review, 47(3). Retrieved from https://sloanreview.mit.edu/article/the-different-ways-for-companies-to-innovate/

Schroeder, R., Van de Ven, A., Scudder, G., & Polley, D. (1986). Managing innovation and change processes: Findings from the Minnesota innovation research program. Agribusiness Management Journal, 2(4), pp. 501–523. DOI: 10.1002/1520-6297(198624)2:4<501::AID-AGR2720020412>3.0.CO;2-G

Schumpeter, J. A. (1934). Introduction. In: Elliott, J. (ed.). The theory of economic development: an inquiry into profits, capital, credit, interest, and the business cycle. New Brunswick, New Jersey: Transaction Publishers, pp.8, 70.

Schumpeter, J. A. (1947). The creative response in economic history. The Journal of Economic History, 7(2), pp. 149–159. DOI: 10.1017/S0022050700054279

Seaden, G., Guolla, M., Doutriaux, J., & Nash, J. (2003). Strategic decisions and innovation in construction firms. Construction Management and Economics, 21(6), pp. 603-612. DOI: 10.1080/0144619032000134138

Sergeeva, N. (2013). Making sense of innovation in the UK construction sector. Procs 29th Annual ARCOM Conference, 2- 4 September 2013, Reading, UK, Association of Researchers in Construction Management, pp. 1083-1092. ISBN: 9780955239076

Sergeeva, N. (2017). Labeling projects as innovative: a social identity theory. Project Management Journal, 48(1), pp. 51-64. DOI: 10.1177/875697281704800104

Sergeeva, N. & Trifilova, A. (2018). The role of storytelling in the innovation process. Creativity and Innovation Management, 27(4), pp. 489-498. DOI: 10.1111/caim.12295

Sexton, M. & Barrett, P. (2003a). Appropriate innovation in small construction firms. Construction Management and Economics, 21(6), pp. 623-633. DOI: 10.1080/0144619032000134156

Sexton, M. & Barrett, P. (2003b). A literature synthesis of innovation in small construction firms: insights, ambiguities, and questions. Construction Management and Economics, 21(6), pp. 613-622. DOI: 10.1080/0144619032000134147

Slaughter, E. S. (1993). Builders as sources of innovation. Journal of Construction Engineering and Management, 119(3), pp. 532-549. Retrieved from https://ascelibrary.org/

Slaughter, E. S. (1998). Models of construction innovation. Journal of Construction Engineering and Management, 124(3), pp. 226-231. Retrieved from https://ascelibrary.org/

Śledzik, K. (2013). Schumpeter's view on innovation and entrepreneurship. SSRN Electronic Journal, (April 2013). DOI: 10.2139/ssrn.2257783

The Economist. (2000, January). Construction and the internet. The Economist. Retrieved from https://www.economist.com/business/

Tidd, J., Bessant, J., & Pavitt, K. (2009). Managing Innovation (4th ed.). West Sussex, England: John Wiley & Sons. DOI: 10.1017/CBO9781107415324.004

Turner & Townsend. (2017). International construction market survey 2017: building momentum. Retrieved from http://www.turnerandtownsend.com/en/insights/international-construction-market-survey-2017/

Tushman, M., & Nadler, D. (1986). Organizing for innovation. California Management Review, 28(3), pp. 74–92. DOI: 10.2307/41165203

Usher, A. P. (1954). A history of mechanical inventions. Cambridge, MA. Harvard University Press.

Wan, D., Ong, C. H., & Lee, F. (2005). Determinants of firm innovation in Singapore. Technovation, 25(3), pp. 261-268. DOI: 10.1016/S0166-4972(03)00096-8

Winch, G. M. (1998). Zephyrs of creative destruction: understanding the management of innovation in construction. Building Research & Information, 26(5), pp. 268-279. DOI: 10.1080/096132198369751

Yin, R. K. (2009). Case Study Research (4th ed.) USA: Sage Publications.

Yusof, N. A., Kamal, E. M., Kong-Seng, L., & Iranmanesh, M. (2014). Are innovations being created or adopted in the construction industry? Exploring innovation in the construction industry. Sage open, 4(3), pp. 1-9. DOI: 10.1177/2158244014552424

APPENDICES

A. SAMPLE INTERVIEW FORM

1. General Information about the Company

Name of the Company :	
Date of Establishment :	
Address :	
Main Activity Field :	
Other Activity Fields :	
Total Number of Employees :	
Geographic Markets :	☐ Local/ Regional ☐ National ☐ International

2. General Information about the Project

Name of the Project :	
Partners (if exist) :	
Location of the Project :	
Project Year :	
The scale of the Project (please indicate m^2, number of blocks, budget, etc. whichever is appropriate):	

3. Innovation

a. Product Innovation

Product innovation is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components, and materials, incorporated software, user-friendliness or other functional characteristics (OECD, 2005).

	No Innovation (0)	Innovation within the Company (1)	Innovation in the Region/City (2)	Innovation in the Country (3)	Innovation in the World (4)
1. A new or significantly improved design was introduced.					
Please explain :					
2. A new or improved design software was used for the design.					
Please explain :					
3. New or improved modelling or simulation technologies were used.					
Please explain :					
4. A new living concept was introduced.					
Please explain :					

	No Innovation (0)	Innovation within Company (1)	Innovation in the Region/City (2)	Innovation in the Country (3)	Innovation in the World (4)
5. An advanced or new material (composite materials, recycled plastic components, etc.) was used.					
Please explain :					
6. New or improved technologies or workmanship were used to ensure the quality of the work.					
Please explain :					
7. Green building solutions/approaches (LEED, BEAM etc.) were used.					
Please explain :					
8. Other product innovations.					
Please explain :					

Please assess the overall product innovation performance of your company by using the following scale where 0 is poor performance, and 4 is high performance.

	0	1	2	3	4
Overall product innovation performance					

b. Process Innovation

Process innovation is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software. Process innovations can be intended to decrease the unit cost of production or delivery, increase quality, or to produce or deliver new or significantly improved products (OECD, 2005).

	No Innovation (0)	Innovation within the Company (1)	Innovation in the Region/City (2)	Innovation in the Country (3)	Innovation in the World (4)
1. A new or significantly improved construction method or technology was used.					
Please explain :					
2. A new or significantly improved technology was used in the head office.					
Please explain :					
3. A new on-site plant or equipment (laser-guided equipment, GPS etc.) was used.					
Please explain :					
4. A new or significantly improved information communication technology was used into the construction site.					
Please explain :					

	No Innovation (0)	Innovation within Company (1)	Innovation in the Region/City (2)	Innovation in the Country (3)	Innovation in the World (4)
5. A new or significantly improved communication method (e-mail, office to site video links, company computer networks, etc.) was used in the head office.					
Please explain :					
8. Other process innovations.					
Please explain :					

Please assess overall process innovation performance of your company by using the following scale where 0 is poor performance, and 4 is high performance.

	0	1	2	3	4
Overall process innovation performance					

c. Managerial/Organizational Innovation

Organizational innovation is the implementation of a new organizational method in the firms' business practices, workplace organization or external relations. Organizational innovations can be intended to increase a firm's performance by reducing administrative costs or transaction costs, improving workplace satisfaction (and thus labor productivity), gaining access to non-tradable assets (such as non-codified external knowledge) or reducing costs of supplies (OECD, 2005).

	No Innovation (0)	Innovation within the Company (1)	Innovation in the Region/City (2)	Innovation in the Country (3)	Innovation in the World (4)
1. New or improved relations were established with suppliers.					
Please explain :					
2. New or improved relations were established with universities.					
Please explain :					
3. New or improved relations were established with other construction companies.					
Please explain :					
4. New or improved relations were established with financial institutions.					
Please explain :					

	No Innovation (0)	Innovation within Company (1)	Innovation in the Region/City (2)	Innovation in the Country (3)	Innovation in the World (4)
5. New or improved relations were established with government/ municipality.					
Please explain :					
6. A new or significantly improved cost management method was used.					
Please explain :					
7. A new or significantly improved scheduling method was used.					
Please explain :					
8. A new or significantly improved quality management method was used.					
Please explain :					
9. A new project management method (agile, lean etc.) was introduced.					
Please explain :					

	No Innovation (0)	Innovation within Company (1)	Innovation in the Region/City (2)	Innovation in the Country (3)	Innovation in the World (4)
10. A new or significantly improved project risk management method was used.					
Please explain :					
11. A new or significantly improved health and safety management method was used.					
Please explain :					
12. A new sustainability management method was used.					
Please explain :					
13. A new project delivery method was introduced.					
Please explain :					
14. Other managerial innovations.					
Please explain :					

Please assess the overall managerial innovation performance of your company by using the following scale where 0 is poor performance, and 4 is high performance.

	0	1	2	3	4
Overall managerial innovation performance					

d. Marketing Innovation

Marketing innovation is the implementation of a new marketing method. Marketing innovations are aimed at better addressing customer needs, opening up new markets, or newly positioning a firm's product on the market, with the objective of increasing the firm's sales (OECD, 2005).

	No Innovation (0)	Innovation within the Company (1)	Innovation in the Region/City (2)	Innovation in the Country (3)	Innovation in the World (4)
1. A new location was selected for the project.					
Please explain :					
2. A new market was entered.					
Please explain :					
3. A new customer group segment was attracted.					
Please explain :					
4. This project addressed the customer's needs that have never been met.					
Please explain :					
5. A new differentiation strategy (maintenance services after completion of the project etc.) was used.					
Please explain:					

	No Innovation (0)	Innovation within Company (1)	Innovation in the Region/City (2)	Innovation in the Country (3)	Innovation in the World (4)
6. A new method of pricing was used.					
Please explain :					
7. A new media or technique for product promotion (advertising media, brand image etc.) was used.					
Please explain :					
8. A new technology (virtual reality etc.) was used in marketing.					
Please explain :					
9. Other marketing innovations.					
Please explain :					

Please assess the overall marketing innovation performance of your company by using the following scale where 0 is poor performance, and 4 is high performance.

	0	1	2	3	4
Overall marketing innovation performance					

4. Opinion Questions

Do you think that there is a relationship between sales or prices and innovation in the housing sector? How did your innovative applications affect sales or prices? Please give an example from your company.

How effective are the following dimensions in gaining competitive advantage in the Turkish housing sector? Please indicate your opinion by using the following scale where 1 is very low effect, and 4 is a very high effect. If you think that it is not relevant, indicate NA.					
	NA	**1**	**2**	**3**	**4**
Design of the project					
The living concept					
Materials used in the project					
Quality					
Construction methods and technologies					
Communication					
Project management					
Relations					
Differentiation strategies					
Sales, marketing and price strategy					

B. DIMENSIONS AND RELATED QUESTIONS

	PRODUCT INNOVATION			
	Design	Concept	Material	Quality
Q1				
Q2				
Q3				
Q4				
Q5				
Q6				
Q7				
Q8				
OVERALL				

	PROCESS INNOVATION	
	Construction Methods and Technology	Communication
Q1		
Q2		
Q3		
Q4		
Q5		
Q6		
OVERALL		

	ORGANIZATIONAL INNOVATION	
	Project Management	Relations
Q1		
Q2		
Q3		
Q4		
Q5		
Q6		
Q7		
Q8		
Q9		
Q10		
Q11		
Q12		
Q13		
Q14		
OVERALL		

	MARKETING INNOVATION	
	Differentiation Strategies	Sales & Marketing
Q1		
Q2		
Q3		
Q4		
Q5		
Q6		
Q7		
Q8		
Q9		
OVERALL		