IDENTIFICATION AND MODELING OF CRITICAL SUCCESS FACTORS OF PORTFOLIO MANAGEMENT IN CONSTRUCTION SECTOR

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ABSTRACT

IDENTIFICATION AND MODELING OF CRITICAL SUCCESS FACTORS OF PORTFOLIO MANAGEMENT IN CONSTRUCTION SECTOR

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Project Portfolio Management (PPM) is a good theoretical fit for a multi-dimensional industry like construction, however practical implications are limited. The aim of this thesis is to deeply analyze and investigate the determinant factors on the success of portfolio management in the construction industry. Since few studies have addressed them, both PPM in the construction sector and related success factors could be regarded as newly arising subjects for the literature. Consequently, the main contribution of this study is to fill the existing gap in the literature.

Within this content, project and portfolio data of 22 portfolios consisting of construction projects were compiled from construction industry professionals through a survey. The professionals have been asked to evaluate a construction portfolio in which they took part in their professional lives according to 36 factors specified. In addition, three in-depth interviews were performed with professionals and three case studies were conducted accordingly.

The compiled data is used to identify the critical success factors of construction portfolio management through statistical significance analysis. The critical success factors are used to develop a model of construction portfolio success. The novel model enables prediction of construction portfolio success by quantifying the impact of the critical factors on the portfolio success.

One of the most remarkable findings of this study is that determinant success factors of PPM are differentiated from the projects' success factors, which constitute the portfolios. Furthermore, portfolio related factors and human resources play a prominent role in the success of PPM in the construction sector.

Keywords: Project Portfolio Management, Success, Construction

ÖZ

İNŞAAT SEKTÖRÜNDE PORTFÖY YÖNETİMİNİN BAŞARISINA ETKİ EDEN KRİTİK FAKTÖRLERİN BELİRLENMESİ VE MODELLENMESİ

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Proje Portföy Yönetimi (PPY) inşaat endüstrisi gibi çok boyutlu bir endüstri için teorik anlamda çok uygun olmasına rağmen, pratik uygulamaları sınırlıdır. Bu tezin amacı, inşaat sektöründe portföy yönetiminin başarısını belirleyen faktörleri derinlemesine analiz etmek ve araştırmaktır. Bu konuları ele alan çalışmalar oldukça kısıtlı olduğundan; hem inşaat sektöründe proje portföy yönetimi hem de ilgili başarı faktörleri literatürde henüz çok yeni konulardır. Dolayısıyla, bu çalışmanın literatüre katkısı, literatürdeki boşluğu doldurmaya katkıda bulunmaktır.

Bu bağlamda, inşaat projelerinden oluşan 22 portföye ait proje ve portföy verileri, inşaat sektörü profesyonellerinden anket yoluyla toplanmıştır. Katılımcılardan, profesyonel iş yaşamlarında daha önce dahil oldukları herhangi bir inşaat portföyünü, belirlenmiş 36 faktöre göre değerlendirmeleri istenmiştir. Buna ek olarak, sektör profesyonelleriyle, üç adet derinlemesine görüşme yapılmış ve bu doğrultuda üç vaka çalışması hazırlanmıştır.

Derlenen veriler, istatistiksel anlamlılık analizi yoluyla inşaat portföyü yönetimindeki kritik başarı faktörlerinin belirlenmesi için kullanılmıştır. Kritik başarı faktörleri kullanılarak bir inşaat portföyü başarısı modeli geliştirilmiştir. Geliştirilen yeni model, kritik faktörlerin portföy başarısı üzerindeki etkilerini ölçerek inşaat portföy başarısının öngörülmesini sağlamaktadır.

Çalışmanın en dikkat çekici bulgularından biri, proje portföy yönetiminin başarısını belirlemekte etkin olan faktörlerin, portföyleri oluşturan projelerin başarı faktörlerinden farklı olmasıdır. Bununla beraber, inşaat sektöründe PPY başarısında portföy ve insan kaynakları ile ilgili faktörler öne çıkmaktadır.

Anahtar Kelimeler: Proje Portföy Yönetimi, Başarı, İnşaat

To My Family,

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LIST OF ABBREVIATIONS

ABBREVIATIONS

ANN	: Artificial Neural Networks
CPI	: Cost Performance Index
Fin Tr	: Financial Resource Transfer
KPI	: Key Performance Indicator
Mac Tr	: Machinery & Equipment Transfer
PM Mng	: Project Manager's Managerial Skills
PM Tech	: Project Manager's Technical Skills
PMI	: Project Management Institute
PMO	: Project Management Office
POO	: Project-Oriented Organization
PtM Mng	: Portfolio Manager's Managerial Skills
SPI	: Schedule Performance Index

CHAPTER 1

INTRODUCTION

As opposed to process-oriented manufacturing industries, the construction industry is project-centric. According to PMI, "A project is a temporary endeavor undertaken to create a unique product, service, or result" (Project Management Institute, 2017). Over the years, factors such as more complex construction projects, growth of companies, undertaking more than one project at once and increased competition have led to a search of new methods in project management.

Portfolio Management as a concept first occurred in the finance sector. Investors have started creating portfolios by using multiple investment instruments at different rates and times. By doing so, they were aiming to distribute the risk of the investments. In time, this idea was adopted in project management and the concept of Project Portfolio Management was born. The aim of this was to compensate for the points in which project-oriented management was deficient.

According to study of Global Construction Survey in 2015; in the past 3 years, only 1 over 3 construction projects came within 10% of its planned budget and only 1 over 4 construction projects came within 10% of its planned duration (KPMG, 2015). It is not sufficient to manage projects solitary in an effective manner any longer. In the current business market, dynamically managing the entire project portfolio has become rampantly vital in attaining long term success and competitive advantage (Heising, 2012).

By definition, "Project Portfolio Management (PPM) deals with the coordination and control of multiple projects pursuing the same strategic goals and competing for the same resources, whereby managers prioritize among projects to achieve strategic benefits" (Cooper, Edgett, & Kleinschmidt, 1997a). Although theoretically, this

approach seems very beneficial for the construction industry, the actual practices are rather narrow and the concept itself is newly developing. A lot of companies group their projects into different categories through different factors and group them into portfolios; however, they still manage these projects independently. As a result, they are still deficient in the transfer of knowledge, technology, resources and personnel (Wu, Zhang, & Xu, 2016).

There are certain barriers that need to be knocked down to effectively implement PPM in construction projects. When properly applied, PPM practices can have great benefits for companies in the areas of project management and setting strategic goals. Hadjinicolaou and Dumrak (2017) have studied PPM and in their study, they have summed up the benefits of the PPM applications as follows:

- Improvement of decision making,
- Optimal allocation of resources,
- Decreased costs,
- Better alignment of project and business strategies,
- Reduction of organizational risk,
- Increased profits,
- Demonstration of value for critical stakeholders,
- Improved time to market,
- Repetition of success.

In their study, Hadjinicolaou and Dumrak (2017) summarized the barriers encountered during application of PPM for the companies as follows:

- Absence of wide organizational support,
- Agreement on prioritization of projects,
- Lack of systems which provide data for management of performance,
- Insufficient resource information,

- Internal politics and culture,
- Change in business priorities,
- Not having enough projects to implement PPM efficiently.

Portfolio management has the utmost potential of being beneficial to the construction industry. Nevertheless, current applications of the field are still limited. The purpose of this study is to shed light on the factors which affect portfolio management success. In addition, the study investigates the factors affecting singular project success and the effect of those factors on portfolio management success, as well as their relation to each other. In doing so, the study aims to provide insights to companies who wish to put PPM practices in place.

The notion of PPM is as new to the literature as it is to the industry. Even though project management and success factors of project management are studied frequently, studies on PPM and success factors of PPM are still very much limited. Even though PPM has gained popularity over the recent years, studies on the matter remain inadequate both in the world and in Turkey. The aim of this study is to contribute to filling the gap in the literature.

The main hypothesis of the study is that the most important factors of portfolio success are related to factors related with the projects, which constitute the portfolios. In addition, the resource transfer between projects, which is done to optimize the allocation of said resources, positively correlates with portfolio success.

The data collection methodologies used in the study are survey and in-depth interview. Project and portfolio data of 22 portfolios consisting of construction projects were compiled through a survey. The participants were asked to evaluate a construction portfolio that they were a part of in their professional life according to the 36 factors given to them. Evaluations were done for each and every project forming the portfolio. Moreover, some general questions about the portfolio itself were also asked. Lastly,

participants were asked to answer some open-ended questions in an attempt to better grasp their perception on the matter. In addition to the survey, three case studies have been formed by conducting in-depth interviews with construction professionals about PPM and its application in the construction industry.

The following chapter continues with a detailed literature review. In this chapter, the definition of PPM, PPM in construction industry, definition of project and portfolio success and factors contributing to project and portfolio success in the literature are examined. In the next chapter, the survey process is explained, and statistical analysis and modeling procedures are mentioned in detail. Later, the data collected from the in-depth interviews and case studies are presented, which is followed by the conclusion chapter.

CHAPTER 2

LITERATURE REVIEW

In this chapter, a detailed literature review is provided regarding with definition of PPM, PPM in construction industry, definition of project and portfolio success and factors contributing to project and portfolio success.

2.1. PPM Theoretical Background

A theoretical background review would help to form a solid foundation for the further analysis of the literature related with PPM. In the following two sections, definition of PPM and PPM in construction industry will be examined.

2.1.1. Definition of PPM

Before making a Project Portfolio Management (PPM) definition for construction projects, a general definition of PPM given by Project Management Institute (2017) is provided:

> Project Portfolio Management (PPM) is the centralized management of the processes, methods, and technologies used by project managers and project management offices (PMOs) to analyze and collectively manage current or proposed projects based on numerous key characteristics. The objectives of PPM are to determine the optimal resource mix for delivery and to schedule activities to best achieve an organization's operational and financial goals, while honouring constraints imposed by customers, strategic objectives, or external real-world factors.

Kaiser, El Arbi and Ahlemann (2015) simplify this definition to, “PPM is a commonly employed technique to align a project portfolio with strategic goals.” Another simplistic definition that can be described as a “broad term” is from Patanakul (2015) who simply states PPM as the coordinated management of a collection of projects or programs to achieve specific organizational objectives.

Martinsuo (2013) quotes Cooper (1997) about description of PPM and states that PPM deals with the coordination and control of multiple projects pursuing the same strategic goals and competing for the same resources, whereby managers prioritize projects to achieve strategic benefits.

Gutiérrez and Magnusson (2014) make their definition by deriving from Jonas (2010), Killen and Hunt (2010) and Tidd and Bessant (2009). They mention PPM as a management system that aims to provide a coherent basis to judge the development of projects, which should be undertaken by organizations.

PPM deals with analyzing previous work for success and attempts for make a future plan based on that analysis. However, in the construction industry whether something is successful and even management's role and effect on it is something still in debate. Therefore, in discussing what PPM means for construction industry, it should be taken into account that both of these areas are debated, and PPM, being a relatively new concept, remains uninvestigated.

Research on PPM has been investigated for a while and has been shot from different angles. Some studies emphasize on the importance of project selection process and size of PPM, whereas others focus on evaluation, optimization and balance. This is because much of the PPM research is regarding with R&D and IT sectors that focuses on those factors (Wu et al., 2016). The fact that literature is richer in investigating one area of PPM, a multidimensional system, creates a lack of systematic review.

2.1.2. PPM in Construction Industry

PPM is relatively new concept, but it is especially true for construction industry. This is somewhat curious as construction industry is not exactly lacking in multi-project management problems. Many companies work on multiple projects of various types and sizes. Therefore, it would stand to reason that PPM is a good strategy management option for construction industry. Despite the theoretical fit, PPM is scarce in construction industry (Wu et al., 2016).

Before exploring the reasons before the scarcity of PPM in construction industry, it would have been proved helpful to look at the history of PPM. However, there is not enough literature that developed around the subject. Next best thing would be to look at the history of strategic management in construction industry since PPM is after all a strategy management tool.

Lansley (1987) introduced a new framework for the altering marketplace which aimed linking strategy, skill set and structure in a construction firm. Another highlight is Betts and Ofori (1992) integrating five forces of Porter (1979) into the construction industry. These management strategies include singularity of individual projects, industry fragmentation and the intensity of management. After studying strategy formations in the construction industry, Junnonen (1998) deduced the nature of the industry as making execution hard for managers. An interview analysis by Chinowsky and Meredith (2000) mentioned that although managers in the industry believe in the vitality of strategizing in theory, they tend to fall short in practice. De Haan (2002) introduced strategy as a critical success factor, which was taken further by Green (2008) who claims strategic management must do company's won expertise. Another important study is the study of Price (2003) in which he examines the strategy frameworks and unifies them in an attempt to show just how badly strategy implementation is in the construction industry. A very significant study which point the finger at the resource transfer in a company and business environment in strategy

selection is effort of Warszawski (2007). There have been some studies regarding strategy in Turkish literature as well. Kazaz and Ulubeyli (2009) made a SWOT analysis of the Turkish construction industry regarding management practices which resulted in the notion that the implementation not being at the desired level. Another study is by Isık, Dikmen and Birgönül (2010), who used a structural equation model to deduce success criteria, only to find that strategy management exacts its influence on the other criteria.

This rough timeline is very important in analyzing PPM in the construction industry as it highlights the evolution of the perception of strategy. Earlier studies find "strategy" to be a success criterion. However, links to the management and resources need to be discussed further. In the construction industry belief of management and strategy hold importance to project success is agreed upon both academics and managers. However, how to go about actually implementing these into their projects remain ambiguous. Therefore, PPM as a strategy and management tool seems to be the next natural step for the industry and it fits the complex nature of the industry rather well. Then it begs the question, why PPM is still not fully embraced by the industry despite having a clear need in an effective strategy tool for project-based management.

One major reason why construction industry did not widely embrace PPM is because PPM originates from financial sector portfolio management (Wu et al., 2016). This is also true for Turkey and Turkish finance sector, especially banking sector. Patanakul (2015) in his research of interviewing PPM executives choose subjects from finance and IT related industries.

Another reason why construction industry fails to fully embrace PPM is established management models which are traditionally very project centric. A manager sees a project from start to finish which makes the project management quite independent. A drawback of that in terms of PPM is that these independent projects lack

communication in terms of resources, techniques, practical problem solving and so forth. In other words, it prevents a PPM base to be formed.

In conclusion, it could be said that although PPM is a good theoretical fit for a multi-dimensional industry as construction, practical implications are limited and even inconvenient in some cases, preventing PPM to be fully embraced by the construction industry.

Yunna Wu, Haobo Zhang and Hu Xu (2016) in their study on PPM in construction industry state that, although theoretically PPM is a viable option for construction industry, the practical implications are reduced due to practical reasons. This study is quite noteworthy as it is one of the rare studies that not only investigates PPM in construction industry but actually proposes a PPM model for it. Wu, Zhang and Xu Model suggests a three-dimensional PPM framework tailored for the construction companies.

First layer of the framework deals with project type. Although there are many types of construction projects that can be further subdivided into categories, generally they can be grouped as residential, commercial, industrial or infrastructural. Construction companies of various sizes deal with projects in either category which require different technology, knowledge, resources, and management methods. Therefore, authors point out the importance of a preliminary segmentation. This because after having done so similar projects can be grouped into the same portfolio, decreasing the complexities of the project selection process of PPM.

The second dimension is the project phase. A project has many different phases and there is not one general method of dividing them. However, it can be said that payment occurs at the end of the phases and smaller construction companies may specialize in one phase of a project. This is not necessarily a setback. Just like type selection it provides a flexibility since different phases are like subprojects. The second layer of

Wu, Zhang, Xu Model is built with these subprojects and because the phases are juxtaposed, they propose the phases are divided into further segments.

The third dimension is the management layer. Authors suggest, to complete the final layer, the segments of the second layer are divided into categories of decision making, schedule, and execution. The categories are later assigned to managers; senior, middle and project managers, thus completing the third layer and creating a base for PPM.

2.2. Project and Success Definition in Construction Industry

Construction portfolios require centralized management of multi projects to achieve strategic goals. As a result, before further analyzing the construction portfolios and the factors affecting success of them, it would be beneficial to understand success definition for the construction projects.

Construction industry is a project-intensive industry. Therefore, in order to grasp the concept of success in construction projects, a definition of a construction project itself is essential. A project definition should be broad enough to include all the organizational activities to reach certain goals. This definition, at the same time, should be narrow enough to define the organization to be project based (Pinto, 1986). There are many definitions of project in the literature. Wideman (2000) defines a project as a means and action to reach desired goals which have a definite start and end point as well as a predefined conclusion which include certain goal. Cleland and Kerzner (1985) describe a project as bringing human and nonhuman resources in order to reach appointed goals in a temporary organization.

Chitkara (2013) defines a construction project as: “A mission undertaken to create a construction facility or a service with predetermined performance objectives with the involvement of different project participants with different expectations”. For the

purposes of this study, Chitkara's (2013) version of a construction project definition is also valuable.

When the descriptions of a project are analyzed, it can be said that the concepts which forge the definition are highly linked to the success criteria because the main focus of all definition are linked to "preset goals". Another importance of project definition has to do with project phases. According to PMI, there are five phases of a project; initiating, planning, execution, monitoring and controlling and closing. In successful organizations, although many projects are proposed, very few actually come to life. As a result, earlier termination of the projects or changes in the projects are less damaging economically (Demir, 2006).

In terms of success perspective in construction projects, it is impossible to define a one-size-fits-all definition. This happens due to a few factors the primary of which is each project having its own circumstances and goals. The parties which bring a construction project together like the project manager, client, contractor, consultant, subcontractor, supplier, and manufacturers all have different expectations and success goals of their own. Therefore, the critical success factors are many and varied.

Sanvido, Member, Grobler, Parfitt, Guvenis and Coyle (1992) argue project success is different for each stakeholder, but it is based on the core concept of overall achievement of project goals and expectations. Belout (1998), has a similar mindset in which he argues success is a synonym for effectiveness, in other words, how well objectives are reached. Chovichien and Nguyen (2013) also support this train of thought, stating, project goals are the most appropriate criteria for project success assessment.

Therefore, a conclusion can be made that whatever performance indicator or success criteria is set, actually reaching it seems to be the general consensus for success. If a broad definition of success is given as "reaching the previously set goal", we can group

them into two main categories: project success and project management success, (Radujković & Sjekavica, 2017). This study later states, "due to the existence of many different models of both project and project management success, it is hard to make a strong differentiation between them, mostly because of their mutual relationships." which brings us to the next point of success definition in construction projects. Silva, Warnakulasooriya and Arachchige (2017) add “Project success, project management success and project performance are sometimes a bit confusing because, these words have been used in different ways by different researchers in the literature.”

This situation brought the literature to present many success definitions which have been carved into methodologies. In this study, widely accepted methodologies, as well as unique methodologies, will be introduced. Later they will be analyzed in the subsets of critical success factors and key performance indicators.

Pinto (1986) developed a methodology for success. His definition of success repose on many different success criteria including the criteria mentioned in project definition, making his methodology very feasible for construction projects. He also ties the key performance indicator to time management, which again, is very important in construction projects. Pinto (1986) argues effective success criteria to be technical ability, organizational ability and organizational effectiveness.

Another methodology for success is presented by Kerzner (2014). He is known for his business mind and his definition of success is similar with Pinto (1986). However, Kerzner’s (2014) success definition involves the changes in the lifespan of projects which is very valid for the construction industry. Another importance of his success criteria involves the human interactions, namely, when a change must be made, the participants should be open minded about compromises.

Pinto (1986) and Kerzner's (2014) success methodologies are widely accepted and applied due to their in depth understanding and techniques of success. However, there are other studies in the literature which are also worth to mention.

Baker, Murphy and Fisher (1974), argued if the projects meet the technical requirements, satisfies the end user, the organization and the management are satisfied with the end result, then the project is successful. Cleland da Baker (1999) stated a similar definition; project success is achieved when budget, schedule and technical performance met the goals and satisfied the customer. Their argument is a successful project to be the execution of a well-planned strategy.

How these definitions apply to construction projects is the next step in understanding the success for construction projects. Silva et al. (2017) in their meta-analysis regarding construction project success, concluded their imprint as such: "The perceived degree of achievement of predetermined performance objectives and participants' expectations of the execution of a construction facility or a service".

Literature is in alliance with this imprint. Gudiene, Banaitis, Banaitiene and Lopes (2013) underlined that construction projects are very variable and influenced by unpredictable factors. They also point out the following paragraph from the study of Chen et al. (2012); which emphasizes the effect of organization and team work:

> Success in construction projects is dependent on the effective organization of multiple, specialized teams, each of which brings its own ability, experience, knowledge and skill towards completing the joint project, but which also bring their own objectives, goals and management styles, which may not be entirely complimentary.

Chan, Scott and Chan (2004) state that success of a construction project ties to project management actions, project procedures, external environment, project-related factors

and human related factors. Chan and Chan (2004) later released a meta-analysis for key performance indicators. In their study, they underlined the complexity of success in construction projects due to its multidimensional stakeholder profile, saying, "Although a number of researchers had explored this concept, no general agreement has been achieved. Project success means different things to different people. The criteria of project success are constantly enriched".

In conclusion, it must be mentioned again that there is not a one-size-fits-all definition for success for construction industry. Project's nature and expectations of stakeholders determine a unique success definition for each different construction project. There are however, factors that each project defines their version of success from which will be further discussed in the following sections.

2.3. Performance Factors for Construction Projects

The purpose of the KPIs (Key Performance Indicator) is to enable measurement of project and organizational performance throughout the construction industry (The KPI Working Group, 2000). In the literature there are a few schematic systems which explain the KPIs according to various groupings. Atkinson (1999) takes timeline as a focus whilst determining KPIs.

As illustrated in Figure 2.1, Atkinson (1999) divides factors into three: Process: doing it right, system: getting it right and benefits: getting them right. He points out the importance of planning at the delivery stage, but he also highlights the importance of human interaction, particularly the ones between the participants of a construction project.

Shenhar, Levy and Dvir (1997) has a similar mindset. However, they add the customer not as a mere participant but as a subset. Furthermore, as opposed to Atkinson (1999),

they tie business success as an objective criterion - whether the project efficiency goals were met (See Figure 2.2).

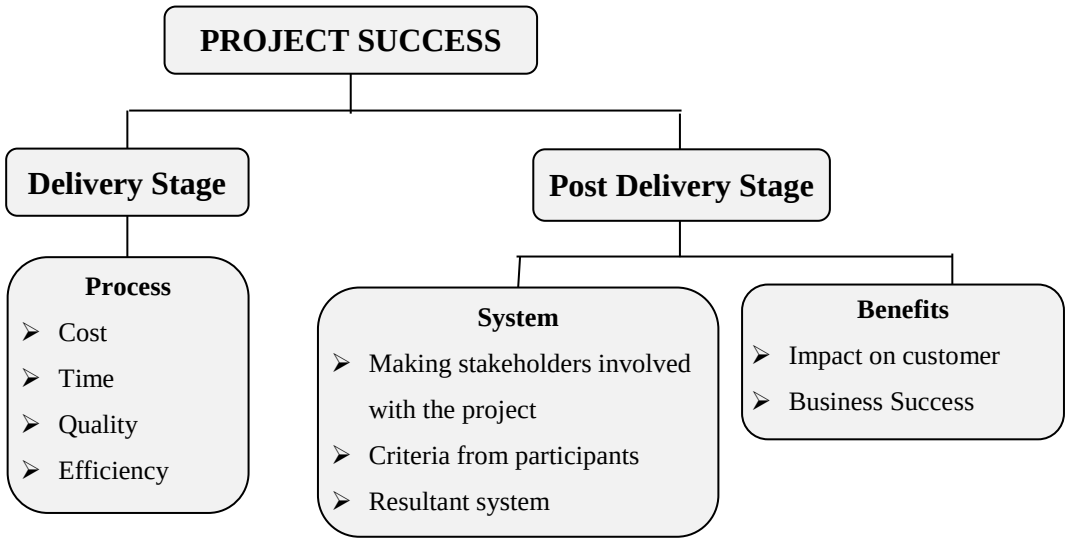

Figure 2.1. Project Success Approach of Atkinson (1999)

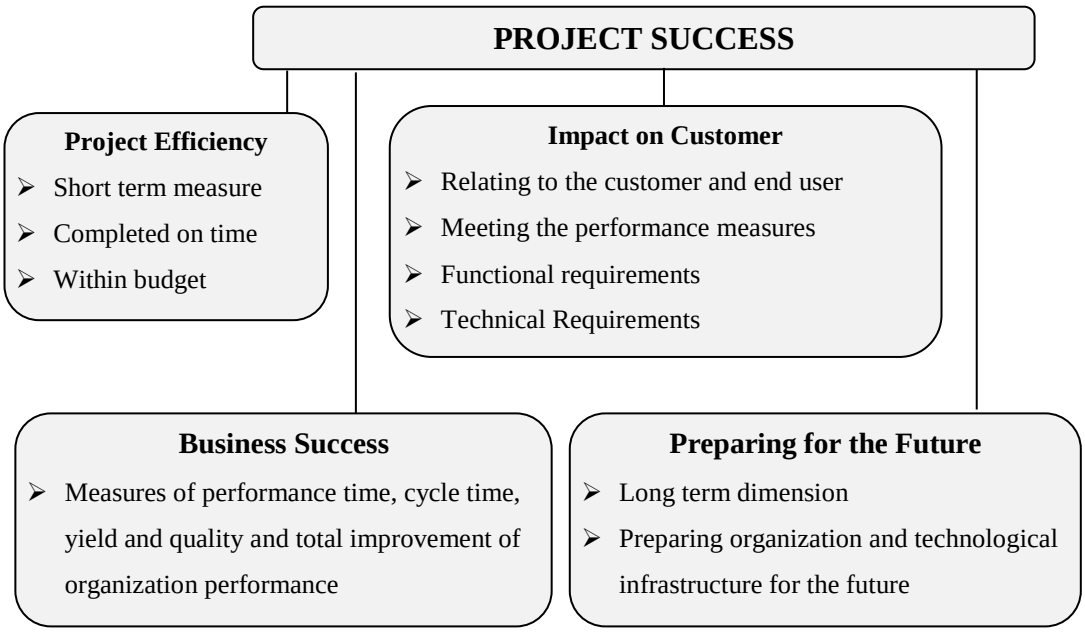

Figure 2.2. Project Success Approach of Shenhar, Levy and Dvir (1997)

Lim and Mohamed (1999) made a simpler and different approach, as they divide performance factors as "micro and macro" (See Figure 2.3). They argued each of these micro and macro factors should be evaluated by the stakeholders of the project.

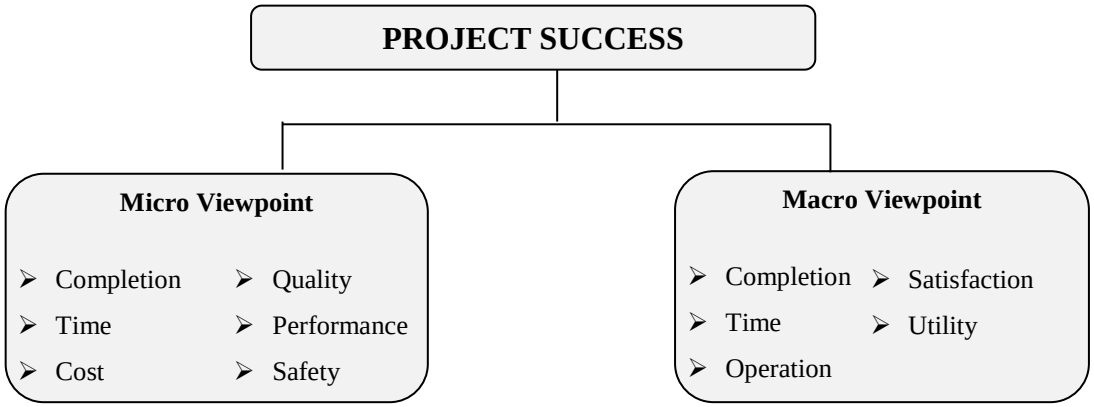

Figure 2.3. Project Success Approach of Lim and Mohamed (1999)

When we explore the KPIs more in depth with the guidelines provided in related literature, we could come to the conclusion that KPIs could be grouped as objective and subjective. Although some of the factors are highly dependent on the perception of stakeholders, some of the factors are in fact, measurable. Therefore, a grouping of objective and subjective criteria makes the most sense.

2.3.1. Objective Indicators

Time is the most obvious objective performance indicators alongside being a determinant in contracts. In literature, time overruns were emphasized to be one of the strongest indicators of project failure due to the strain it puts over the contract, finance, management, and client expectation.

Budget is the second indicator and can affect a project to the extent of abandonment especially in the case of time overruns. Budget needs to be carefully planned out yet needs to be left flexible enough because there can be unforeseen circumstances and

expenses in construction projects. Therefore, the budget plays an important role in every phase of a project but especially in the pre-planning phase. Furthermore, the management needs to have a handle on it in every phase of the project.

Resources or the lack of it can play a crucial role. Material resources, as well as human resources and equipment/machinery, are important components of a project. They have to be planned out and managed effectively. Communication with third parties such as subcontractors and procurers must be clear and efficient. Lack of resources or lack of their transportation could seriously damage projects and cause time and budget overruns.

Size of the project matters in the context of the managerial challenge. As the project becomes bigger and more complicated, factors such as the technical and managerial experience of both human resources and the contractor itself come to play. Big and complex projects require efficient communication and management between parties forming a construction project.

As a running theme in the literature review, the study has emphasized time and time again and the fact that both success factors and performance indicators are tied to each other in a web. Objective indicators are not an exception as each of these performance factors rely on one another to come together and make a successful project.

2.3.2. Subjective Indicators

If success was measured solely on the **project related** factors, the indicators would be value, planning, goals, and objectives, project type, procurement, innovation, accidents, and risk. Planning of a project ensures the objective indicators are laid out with the smallest margin of risk and failure. Company's vision or its goals and objectives are important as with each project a company's further direction in growing and sustaining is affected which is also true for the project type. Without proper

procurement, time and budget goals are compromised. Innovative ideas can be useful for problem-solving which is an essential skill in the industry as well as innovative machinery and design can move a contractor to a new level in addition to making the contractor more efficient. Accidents can overwhelm timelines and budgets and therefore not only the planning phase has to assess risk and leave room for such occurrences but also take the proper precautions.

If the success of a construction project was based on the **project manager** the indicators would be competence, experience, technical skills, leadership skills, motivation, co-ordinational skills, problems solving skills, contract management and risk management. The project manager as the authoritative who runs the project is expected to perform in various areas which affect the said project's success. A well-seasoned project manager is not only competent and collected in terms of crisis but also more efficient in avoiding them with his/her experience. Project manager's own motivation as well as motivating his/her subordinates to depend on his/her leadership and coordination skills. A project manager who performs well in contracting and risk assessing phases will consequentially reduce some of the problems related to an insufficient contract and unseen risks can create.

Management and team members related indicators are experiences, competence, effective troubleshooting, motivation, decision making, technical capability, personnel management, and communication skills. Management or more specifically the style of management will impact onsite motivation and mood as well as administrative issues. Management and team members who work in clear communication are most likely to contribute to a project's success. Similarly, management and team who have previous experience will bring a better technical performance. One thing that stands out in this group of indicators is troubleshooting. Problems can be better avoided or solved if they are able to be spotted early on and addressed to in the right direction to the right correspondent, making experienced and problem-savvy management and team invaluable.

For a construction project be successful, **clients** would ideally perform in the following, experience, size, influence, ability to participate, risk perception, and effective decision making. In addition, whether the client is private or public also plays a role, mostly due to the fact that the difference determines the attitude in the other indicators. A client can play a role in a project' success more than it is being given credit for. A client, who is unsure about wants and needs and subsequently poor at communicating, will create disputes. On this note, a client's size, power and experience also play a role as it determines their influence on the project in its various phases. Furthermore, they affect the client's risk perception which holds the power to underwhelm the project as well as overwhelming it.

The factors which determine the **contractor**'s performance are company characteristics, technical and professional capability, experience, economic and financial situation, management skills, health and safety standards and capabilities, subcontracting and quality policy. Technical and professional capability, as well as experience, are obvious performance indicators as it determines the scope of projects a contractor can deliver. Resource management, whether material or human rely on the contractor's financial situation as companies with strong financial position have the ability of compensating latencies or general problems regarding finance. Health and safety standards and quality policy determine a contractor's future as parties across the board are more likely to give credit, commend, and want to continue working in the future with contractors who have mindful of these matters. Therefore, it is essential for a contractor to consider these factors when planning their goals and vision.

2.4. Effective Success Factors for Construction Projects

Discussing key performance indicators proved just how complex and diverse the perception of "performance" is to stakeholders of construction projects. Therefore, the

first question to explore before searching for success factors is whether they are equally complex and diverse.

The term “critical success factors” or “effective success factors” as used in this study stems from Rockart (1982) who shot the issue from both project and managerial context. Sanvido et al. (1992) in their article regarding success factors point out, after ten years of consecutive studies, there is not much change in construction industry, and we could only slightly better understand the factors that make a project successful. Three decades after that, the same statement preserves its concern.

In their study, Sanvido et al. (1992) selected 16 projects which were divided in eight pairs due to their similarity in scope and proposed by the same sponsor. Each of these pairs contained one successful and one unsuccessful project. The study later analyzed what went right and wrong, eventually coming up with 35 success factors in conclusion of their study. They group the success factors under the key stakeholders of the project; owner, designer and contractor (See Figure 2.4). This study points out to the same concept in key performance indicators. Each of the participants have their own expectation, needs and goals from the project.

Owners are primarily focused on profitability and therefore marketability which all ties to client satisfaction. They want aesthetically pleasing and quality construction which are easy to market with a satisfactory profit margin while not encountering time or budget issues and of course as little disputes on site as possible.

Designers have other priorities. They want their scope of work to be defined in their contract as clear as possible and avoid any improvised or last-minute design changes as not only it is likely to harm design’s aesthetic integrity and original vision but also leave them open to liability. Another concern is being paid on time. Contractors have similar concerns to owners however they have the added burden of their subcontractors. Another obvious concern is safety.

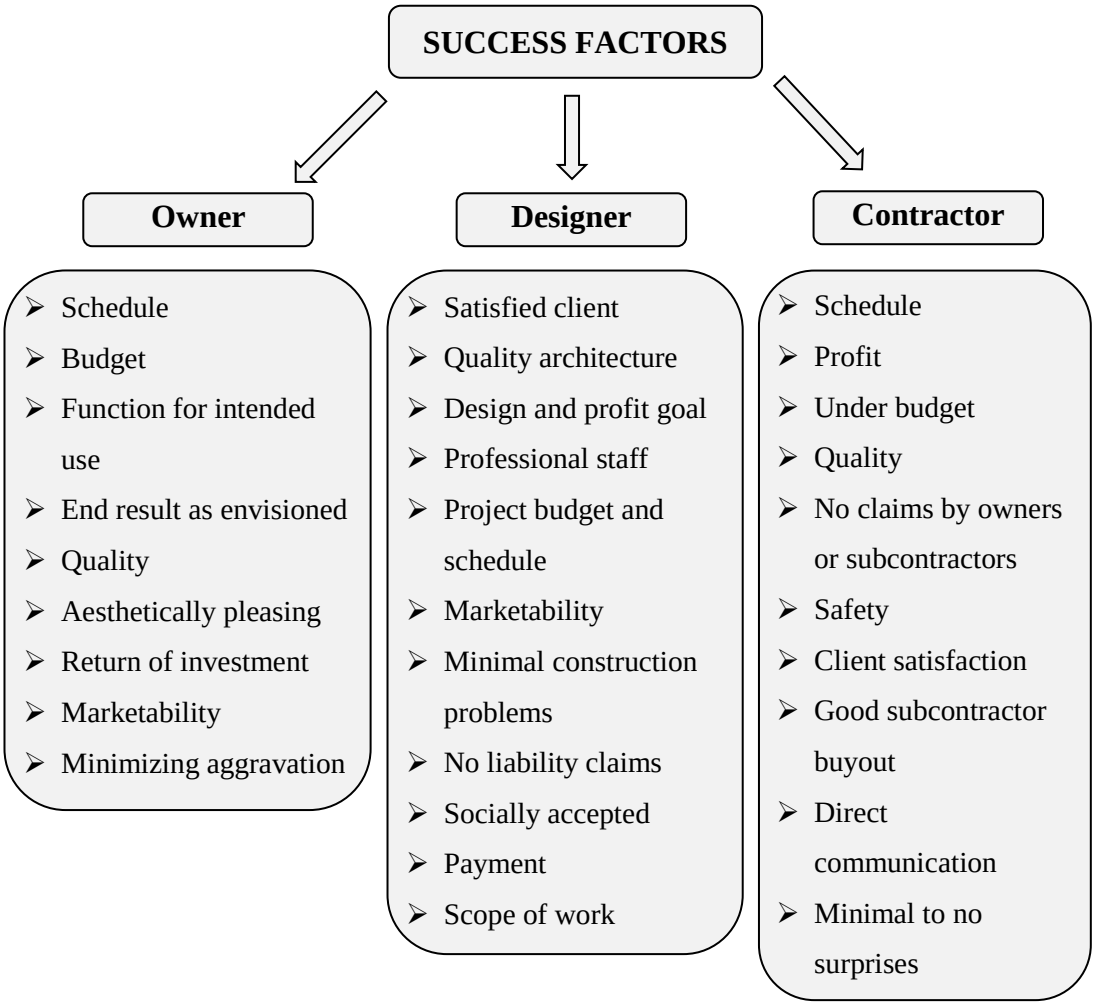

Figure 2.4. Success Factor Groups (Sanvido et al., 1992)

In conclusion to this study's success criteria, each stakeholders of a construction site have their own priorities. When these priorities clash, they start blaming each other, often leaving everyone in a bad position which was pointed out and tried to be solved by a contract clause which was the subject of study of Rowlinson and Cheung (2015).

However, Rowlinson and Cheung (2005) take an entirely different approach based on a case study in Australia. In this case study a "no dispute" clause was added to the contract. The clause ensured each party maintained an interest in maximizing the performance of the other party other than simply viewing issues from a self-interested standpoint. This is a unique viewpoint as the study suggests the success factors which

are subjectively varied among parties can be simplified, if they set aside dispute and dedicated themselves to the success of the project as a whole. Therefore, they argue trust, teamwork, open communication and collaboration are the real success factors.

In their meta-analysis of 102 articles, Silva et al. (2017) give a very good output of literature's view on success criteria. They divide the success criteria under a few focal points which works really well with performance indicators that tend to be subjective and in relation with parties' own agendas.

According to the meta-analysis, effective success factor criteria can be examined under above groupings which are: time and cost, quality, safety, profitability, cash flow management, environmental performance, learning and development, client satisfaction and employee satisfaction criteria (See Figure 2.5).

Many construction projects face with time and cost overruns and several studies in the literature examine these as the core problem of construction industry. Whereas time can be measured by construction time, cost overruns are a bit more complicated. Chan and Chan (2004) argue budget should not be just the tender sum and should include other fees such as legal fees. Another idea that it can be measured by CPI - the cost performance index.

Quality is a concept that determines success in nearly all fields however, in the construction industry it is related to technical performance and functionality which are different criteria on their own. It is worth noting that quality is sometimes the sole success criteria for studies although in that case the term "quality" has a much broad definition and linked to other criteria. Takim, Akintoye and Kelly (2014) consider quality a post-production metric whereas Chan, Scott and Lam (2002) states quality, technical performance, and functionality are closely related and considered important to the owner, designer, and contractor. Safety is a narrower term and as a success criterion can be defined as the project being completed without major accidents or

threats to overall well-being of the workers. Most countries employ audits and guidelines to take proper precautions.

Figure 2.5. Effective Success Factor Grouping (Silva et al., 2017)

Client satisfaction has criteria like project functionality, aesthetic value, client satisfaction on service, end-user satisfaction on product, pleasant environment and easy maintenance under it. Heravi and Ilbeigi (2012) state this group has as much as 28 sub-criteria. Client satisfaction also ties to profitability and future references and therefore its significance is undisputed.

Employee satisfaction is often ignored and overshadowed by client satisfaction criteria, although employees are often the main participants in a construction project. However, this is ill practice as the quality, experience and technical capabilities of an employee on site are a huge impact on project success and qualified employees are more likely to choose to work with contractors and managers who value employee satisfaction.

Learning and development is another group of criteria that is shadowed by some of the more impactful groupings although some studies have found it to be important.

There is no denying in whether a project was a success or failure, there are lessons to be learned in each, which is common subtitle in most studies in literature.

Profitability is obviously very important for any business and construction industry is not an exception. However what profitability means is a matter of perception. While Chan and Chan (2004) refer to commercial profitability, others consider a profit as in whether the total net revenue over total costs.

Environmental performance is not only important for company reputation but is also a moral standpoint in its effect to all beings. For a project to be successful in terms of environment, it needs to minimize its impact to complete the project. Heravi and Ilbeigi (2012) propose a seven-point scale to measure it.

Cash flow management is vital to a construction project. Not only budget runs are frowned upon, but lack of the positive cash flow could also seriously harm the lifecycle of a construction project. This criterion is heavily linked to time and cost criteria as well as post project criteria. Companies need to employ stable cash flow management to avoid any dispute, since project performance heavily depends on it.

In conclusion it can be said that just like the key performance indicators, the success factors are also a tangled web, constantly stemming from and affecting one another in significant ways and are relatively subjective for stakeholders of the construction projects, not to mention the criteria and sub criteria reach really high numbers.

The study that perhaps analyzes the tangled web best belongs to Chua, Kog and Loh (1999), which approach to the topic from a different angle. They propose different success factors in relation to their objective which are explained in various figures. These objectives are project characteristics, contractual arrangements, project stakeholders, and interactive processes. The authors thoroughly explain the relations

between them before going into success factors. Under these four objectives they come up with 67 different critical success factors.

Firstly, they lay out the components of a project which are project characteristics, contractual arrangements, project stakeholders and the interactive process. These components later tie to budget, schedule and quality performance. In other words, all the components must perform for a project to be successful.

Secondly, they lay out the participation scheme of a construction project. The stakeholders are listed as project manager, client, contractor, consultant, subcontractors, suppliers and manufacturers. While project manager's success factors are competency, authority, motivation, commitment and involvement the rest of the group share a different set of factors, namely; capability of key personnel, competency of project team, team turnover rate, top management support, track record and level of service.

And lastly, they study the interaction between the stakeholders and the success factors that build up from that interaction. They divide the stages of interactions into four stages: communication, planning, monitoring and control, and project organization. Communication is assigned to formal and informal design as well as formal and informal communication. Planning applies to functional plans, design completion, constructability program, modularization, level of automation and level of skilled laborers.

Chua et al. (1999) perceive success not as a preassigned schematic in which everyone has to deliver their duties for their individual satisfaction but rather a collective series of objectives in which everyone has a participation duty in the network.

To answer the question of "What makes a construction project successful according to the existing literature?" we can say that the literature is far from coming to a

consensus. Although there is still no consensus, there are a few common phenomena which could help us better understand the subject:

- Each stakeholder has a different idea of success and therefore a different success criteria.
- There must be communication and understanding between stakeholders to achieve success.
- The disputes between the stakeholders have negative effects on the construction projects.
- Being on time and on budget are considered a success factor by almost all of the stakeholders.
- Time and cash-flow management is general a success factor because it prevents overruns.
- The attitude, experience and capability of management sets the general tone for workplace and affects almost every performance indicator including employee satisfaction and the relationship between participants, mainly owner and contractor. Another obvious gain of effective management is workplace safety.
- Planning is another success factor. If cash-flow and the schedule is planned thoroughly and has flexibility for unforeseen problems the operation is more likely to go smoothly.
- The quality and the scope of the contract is very important, as it defines legal guidelines for the participant interaction and makes it easier to deal with disputes in a professional manner. The contract being as clear and comprehensive as possible is a success factor.

In conclusion we can summarize the success factors not as a chart but as an operation, much like the construction projects itself (See Figure 2.6).

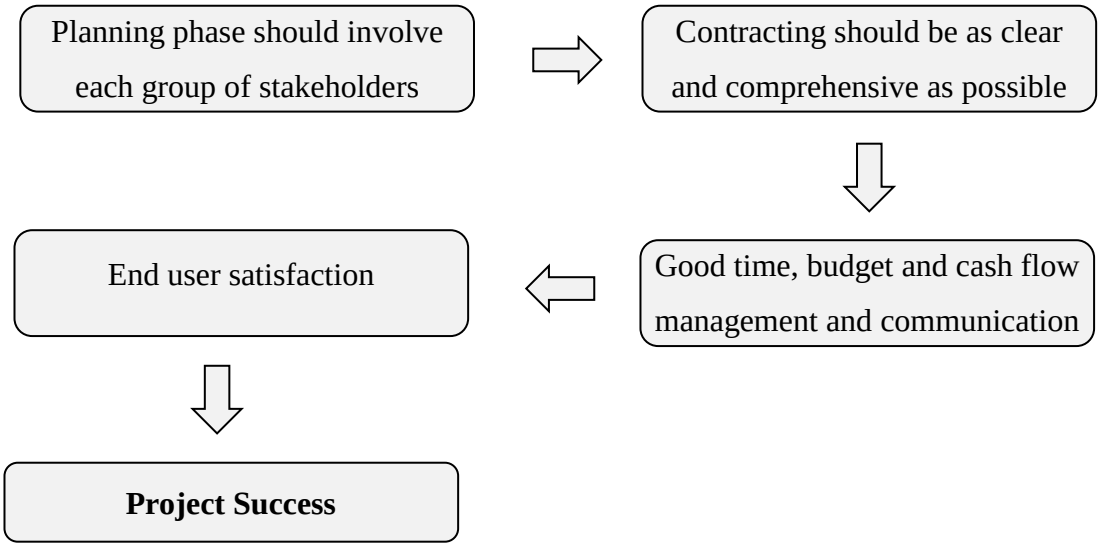

Figure 2.6. Project Success

2.5. Success Definition for PPM

When a success definition for Project Portfolio Management is considered the very broad one would regard its strategy achieving feature. Companies could be regarded as successful if they achieve their strategic goals with PPM applications. However, as mentioned before PPM has two more characteristics. It analyzes previous work in terms of resource management and determines projects to undertake in the future which are vital for the company.

Kaiser et al. (2015) describes PPM success with a diagram. They divide the process into five stages: Market environment, strategic response, PPM adjustment, structural response and PPM success. The idea behind the diagram is that when there is a strategic threat in the market environment, the strategic response is to create a centralized strategy development (PPM). When the PPM adjustment is installed, project selection is derived from strategic goals or PPM is centralized for strategic decision making. Then the structural response would be the need for information that rises from selected criteria which would lead to structure aligning information processing contingencies. Therefore, PPM effectiveness would improve, and PPM

success would have been achieved. This model of success criteria for PPM is in alignment with the proposed success definition of the study and helps to compartmentalize the success criteria which will be discussed in subsequent chapters. In summary, Kaiser et al. (2015) describes PPM success as achievement of;

- PPM being the baseline of management,
- Prioritizing goals for project selection process,
- Creating a flow of communication.

Purnus and Bodea (2014) agree with Kaiser et al. (2015) on project prioritization and performance measurement although their success definition is slightly different and from a project-oriented organization (POO) point of view. They state POOs tend to perceive successful portfolio project management as a competitive advantage and establish a formal PPM system which should ensure that with limited resources and available time, the organization selects the projects that facilitate its success. Purnus and Bodea (2014) point out the importance of the following;

- Selecting projects,
- Evaluating their success,
- Applying proactive management,
- Considering goals and strategies.

Patanakul (2015) is another researcher that emphasizes the key attributes regarding PPM performance. He states the success is measured by its impact on business results. He proposes a three-dimensional performance. First dimension is the representation of different perspectives and interests of stakeholders. Second dimension is accomplishment of multiple PPM goals. The final dimension is effectiveness of the outcome of PPM regarding its initial goal. In conclusion he divides the performance criteria into following categories;

- Strategic attributes
- Strategic alignment
- Adaptability to changes
- Expected value of the portfolio
- Operational attributes
- Project visibility
- Transparency in decision making
- Predictability of project delivery

2.6. PPM Success and Performance Factors in Construction Industry

PPM is a relatively new concept as a management style and the literature on the subject is equally new. Costantino, Di Gravio and Nonino (2015) conducted a study which explores project selection in portfolio management in depth. They also make a reference to this fact, stating a large and growing portion of the literature focuses on analyzing the core reasons affecting project success, the use of these results in project portfolio management is being investigated which draws the conclusion similar to our original point - PPM for construction projects and its effect on success is vague. Therefore, one of the keys concepts in understanding PPM for construction projects is the methodologies used for selecting the projects.

Costantino, Di Gravio and Nonino (2015) point out, project selection has gained an ever-growing attention since the 80's. They add, in project portfolio management, the gathering of possible projects, their prioritization and selection usually involve particular optimization algorithms and management techniques that makes use of specific project selection criteria. The literature on project management offers several project selection methodologies. Although these studies vary from decision making models to more unique systems such as genetic algorithm-based methodologies, they can generally be gathered under the umbrella of being multi criteria scoring. The reason why their idea was chosen for this study is their approach at PM models which

is compatible for construction industry and the proposed PPM definition of this study. The model of Costantino, Di Gravio and Nonino (2015) advices the application of artificial neural networks (ANN) for three reasons. Firstly, ANN is easy to use due to its extracting of implicit knowledge from past experience. Secondly, it is applicable to any industry, project type and critical success factor framework which is great for construction industry. Lastly, ANN has a dynamic learning capability which allows project evaluation during the project lifecycle.

Project selection technique is one that is relatively accepted and most searched topic regarding PPM. However, this is not very viable for construction industry, because selection is one of many factors in construction project portfolio and there are many other techniques and factors that go into PPM than just the selection.

Kaiser et al. (2015) point to this very fact in their study. They argue although selection techniques are of crucial importance, the implementation of strategic goals are equally important, and it ties to organizational structure alignment. Therefore, they propose a new approach to PPM. Their theory integrates strategy implementation, organizational information processing, and structural adaptation. They call their PPM technique structural alignment which they claim to be precursor for the future of PPM.

2.7. Summary of Literature Review

The literature on PPM focuses on phases and categories of PMM (i.e. project selection, project prioritization, importance of size in PPM etc.). Few studies develop and propose systematic approaches for PPM, but there is no other study in the current literature that investigates success criteria and performance factors of PPM in construction sector to the best of our knowledge. Rather, the literature hypotheses a factor and look into the case studies to investigate their idea. This is especially tricky for the construction industry which lacks research in PPM. Most of research is done on IT and finance sectors and therefore to put some of those ideas into PPM for

construction could prove unproductive since these industries do not share the multi-dimensional project building and complexities of the construction industry.

There are general understandings that contribute to the success and performance of portfolios which were fore mentioned in the previous chapter. It should be noted that this study focuses on the effects of PPM in construction industry. In addition to that, as stated in the literature review, success could be regarded as a subjective notion and there are many success definitions in the literature. In this study, success is mainly interpreted from the perspective of contractors.

The first criterion that stands out is embracing PPM as a management style that is making PPM the focus of strategy of the organization. This is essential since PPM deals with evaluating projects to pick. Hence, if other success goals get in the way of PPM, it is less likely to function to its full potential.

Another criterion is establishing short-term and long-term goals clearly. Project selection is a big part of PPM and if the organization does not have a set of mission or vision for its future, the selection cannot be based on solid ground which would also undermine PPM effectiveness.

As emphasized, selection is a vital part of PPM. This might become problematic as construction companies often have to select projects based on other criteria as well, that does not necessarily align with vision of their company. Therefore, the next natural step, evaluation is also compromised.

PPM is a strategy management method that can be very rewarding for construction companies. However, the nature and traditional way of management withholds companies from bringing it to reality. The few companies who do apply PPM benefit from it but not to its full potential because of the aforementioned complications (Wu et al., 2016). Therefore, if construction companies of large scales desire to benefit

from PPM as a strategy management method, they would first have to solve inner conflicts on success definitions of their subsections. After bringing their elements to a consensus, they could then set success goals for the company itself and start the selection and evaluation processes of PPM. Otherwise, PPM could not benefit organizations to its full potential.

In conclusion, although there are many studies related with project and project success, literature regarding with PPM and PPM success are very scarce. At that point, this study attempts to contribute to the literature with its findings regarding benefits and barriers of PPM applications, determinant success factors, real world case studies and perception of industry professionals related with PPM and its applications. Besides the contributions to the literature, this study could be beneficial practically from the companies' and sector professionals' point of view.

CHAPTER 3

DATA AND METHODOLOGY

3.1. Data Collection and Focus Group

In the scope of this study, two types of data collection method have been used; in depth interview and project and portfolio data collection through a survey. In depth interview was used to build the case studies of PPM applications of construction companies and they are explained in Chapter 5 – Case Studies.

The other data collection method used in this study; survey, has three sections. The first section (Part A), has been designed with the intention of establishing the demographic structure of participants. The reason why "survey" was chosen as the research method is the aspiration to capture meaningful results and patterns by presenting the participants with factors that have been both researched in literature and confronted in the actual construction industry in a structured form and by extension evaluating the results in the same frame.

With the notion surveying **construction industry professionals** is a favorable way of collecting palpable and anonymous data regarding projects and portfolios, the focus group was chosen as such - the participants for the survey are construction industry professionals. Participants were approached and interviewed in person, by phone, and via email.

The details of the survey are explicated in the following section, which includes multiple choice questions in order to gather tangible and anonymous information about projects and portfolios as well as open-ended questions to better grasp the outlook of the industry professionals of portfolio management and portfolio management success.

3.2. Survey Design

The survey; which is given in Appendix-A, consists of three parts. Questions in the first section (Part-A) were assigned to the demographic structure of the participants. In that, participants were asked their profession, education, professional experience, types, and locations of the projects they participated in as well as whether they have taken office as a project and/or a portfolio manager.

In the second section (Part-B) of the survey, participants were expected to evaluate any construction portfolio that they took part in their professional life according to the criteria given to them. Participants evaluated every project composing the portfolio according to 36 success factors. In order to determine the success factors that will be used in this study, success factors that were researched in the related literature are deeply analyzed. Researched success factors in the literature provided a solid basis and success factors are selected carefully to be surveyed in our study. In addition, the survey includes factors concerning the overall portfolio for which a five-point Likert scale and open-ended questions were employed. At the end of this part of the survey, participants were asked to evaluate each project in the portfolio and portfolio itself in terms of success status (successful or not successful).

The factors inquired in the survey have been grouped into five main successive groups and they are explained in the following sections in detail.

- Project related,
- Company related,
- Human resources related,
- External,
- Portfolio related.

In the final section (Part C) of the survey participants were asked about some general open-ended questions about PPM and portfolio success to obtain some insights about industry professionals' perception about the subject.

3.2.1. Project Related Factors

The project related factors make nearly half of the factors. There are 36 factors investigated and 19 of them are directly related to the project. Portfolios; by definition, are bigger organizations for managing projects together in order to achieve strategic goals and therefore the factors that are important project success are equally vital to the success of the portfolio they form.

Employer type may affect a project's success due to each employer type having different sets of regulations and expectations of the project. Literature review showed the satisfaction of various components of a construction project changes the perception of success. The participants were asked to specify their employer as "government", "private", "contractor's own investment" and "other".

Participants were asked to specify the **bid type** of the projects inside their related portfolios from a list of "open bid", "restricted tender", "negotiated" and "other". Since each of these bid types has their set of rules and regulations, it's a factor in the project's success. Furthermore, it's important for the study as it aims to find patterns.

Participants were asked to denote **project types** according to alternatives that were given to them which includes, "superstructure", "infrastructure", "energy", "industrial facility" and "other". Each of the project type means a different portfolio type and therefore this question is beneficial in identifying success patterns.
Contract as a whole is important in the success of projects and portfolios as they define parameters on which the success conditions are based. To understand the **scope of**

contract on projects participants were presented with the options of "build", "design-build" and "other".

Contract type plays a role in the success of a construction project. Concerning the success of the portfolio as a whole, this criterion can be useful in determining whether different contract types make a difference. Participants were asked to choose from "turnkey", "unit price", "cost plus fee", "mixed" and "other".

Participants were asked to choose from "single company", "joint venture", "consortium" or "other" for the **contractor type.** It is hoped to showcase a pattern in communication's importance in managing as the literature review stated it can affect the project, especially in joint ventures.

Some portfolios contain projects within single country, whereas some portfolios have projects from different countries. Participants were asked to write down the **countries** the projects took place in an open format to reveal locations of the projects in the portfolios.

Budgeting and budget overruns are one of the leading causes of project abandonment and failure of a project. Participants were asked to identify the project budget between the intervals of "0 – 1 M", "1 M – 10 M", "10 M – 100 M", "100 M – 500 M" and "more than 500 M" in US dollars. This criterion will show a link to whether a **contract's budget** makes it less or more difficult to administer in terms of management and resources.

Although there are many other criteria to consider, duration of a construction project may give some clues about the size and complexity of the project. Thus, participants were asked to choose an interval for the **duration of projects** from "0 – 12 months", "13 – 24 months", "25 – 36 months" and "more than 36 months".

In construction projects, there might be additional work created due to circumstances. It may point to a lack of cost calculation, design and/or planning. In this question, participants were asked to specify the percentage interval of the **additional work** had to be done relative to the project budget. The choices were “0%”, “1% – 10%”, “10% – 20%” or “>20%”.

No matter the adequacy of planning and contract arrangements, if and when subcontractors do not deliver their part, it can create a domino effect that can take a toll on the project. The participants were asked to shoot blank if there were no subcontractors, and to rate the **performance of the subcontractors** from “very bad” to “very good”.

Participants were asked to rate the **performance of suppliers.** Procurement is a success factor in that without the timely, right amount and quality of procured materials, parties of the projects will be dissatisfied. Literature review shows the satisfaction, or meeting of the expectations of the said parties contribute to their perception of success.

One other obvious cause of project abandonment is problems related with **funding** of the project. Even if it does not come to abandonment, it can affect procurement, subcontractors, and employees. Participants were asked to evaluate the funding problems (if there were any) between “there were a lot of problems” to “there were not any problems”.

Design is one of the foundation blocks of a construction project. Participants were asked if they encountered any design problems such as deficient details, conflicting designs, project changes, expropriation and to rate the problems from “there were a lot of problems” from “there were not any problems”.

Contract management is another foundation block of the project and participants were asked about the problems they encountered such as missing addendums, the clauses of the contract that were not executed as described, unbalanced risk share and rate the problems from “there were a lot” to “there were not any”.

Budgeting is essential to the planning phase however, how realistic and/or practical the budgeting can be observed once the project is in actual motion. Therefore, the participants were asked to rate the **budget target** of the projects from “far from realistic” to “reasonably realistic”.

Similar to budgeting, **schedule targets** could also be unrealistic, which will put pressure on the stakeholders and overall success of the project. Participants were asked to rate the schedule targets from “far from realistic” to “reasonably realistic”.

Participants were asked to evaluate **scope and quality goals** of the project from “far from realistic” to “reasonably realistic”. Scope and quality depend heavily on budget and schedule as well as the performance of procurement and subcontracting. Therefore, these goals are hard to set and affect the projects’ success.

As the last question of this part of survey, participants were asked if the projects carried **strategic importance** for the contractor and were asked to answer in written format.

3.2.2. Company-Related Factors

Project and portfolio success are linked to the company creating the portfolio in various ways. Experience, the financial state of the contractor and managerial structure of the company all play an important role as discussed in the literature review of the study. Three factors were investigated in this section.

The construction industry's operational scale has a wide range that requires interrelated expertise. Therefore, the more experienced a contractor is in a certain type of projects, the more likely they will be able to succeed. The participants were asked to rate the **contractor's experience level** from "very little" to "a lot".

The financial state of the contractor affects a project's success in a few ways. Firstly, it gives the company the flexibility to compensate cash flow fluctuations, therefore allowing the contractor to stick with planned schedule and budget. Secondly, the companies which do not have such flexibility when coming across unexpected circumstances might be forced to make structural changes such as downsizing, as well as more severe actions such as abandonment of the project.

Construction projects require management on various ends as well as clear and strong communication in between managerial groups and processes. When these links are broken, the project success is affected. **Managerial process effectiveness** was the last factor asked to participants for this group of factors.

3.2.3. Human Resources Related Factors

Literature shows, both onsite and offsite components of a construction project contribute to its success. Engineers, project managers, and portfolio managers although not in a direct hierarchy are required to be fluid in communication as well as having ability and expertise to contribute to processes that are not directly linked to themselves. Therefore, these three components of human resources were investigated under "technical skills" and "managerial skills" coming to a total of six factors.

Technical skills of the engineers are linked to problem-solving and time efficiency of their work. Technical skills of engineers were asked to be evaluated by participants from "very bad" to "very good".

Engineers' managerial ability in communicating with their colleagues and managing the processes they are responsible for are essential for a project's success. Participants were asked to rate **managerial skills of the engineers** from "very bad" to "very good".

Technical skills of project managers link to their ability to comprehend and manage the technical details of the project which carries vital importance to the project's success.

Participants were asked to evaluate the **project managers' managerial abilities** from "very bad" to "very good". A project manager lacking in managerial skills will not be able to cross manage different components of a project, let alone ensuring and maintaining communication between them.

Participants were questioned whether the **technical skills of the portfolio manager** were sufficient or not. Portfolio manager's technical abilities matter in a similar fashion to project manager's, only on a bigger scale and require a wider range of skills which is heavily related to the portfolio's success itself.

Unlike the management of projects, a portfolio manager is responsible for other managerial matters such as strategy and setting strategic goals for the portfolio and the company. Therefore, a **portfolio manager's managerial skills** are vital in terms of portfolio's success.

3.2.4. External Factors

In project and portfolio success, there are factors that cannot be controlled, as well as the ones that can be. Participants were asked to rate the impact of external factors on their projects from "very bad" to "very good". There was also the option of "I have no information". Participants were asked about four factors in this group of factors.

Location plays an important structural role in project success due to its effect on access to the required resources and suppliers, transfer of resources and physical conditions of the site. While an ideal location can contribute to easier management, overall satisfaction of workers on site and cheaper solutions to the problems; a challenging location can severely compromise budget and schedule targets. Therefore, the participants were asked to rate the **convenience of location** for each project within the portfolio that they evaluate.

Financial status of the country has similar effects of the location factor but on a bigger scale. Inflation, interest rates, and central bank regulations dictate the purchasing power of the end user, as well as employer and contractor. However, in countries with low resource cost can be beneficial to the contractor. The contrary, countries with high resource cost may have the opposite effect. For these reasons, the participants were asked to evaluate the economic climate of the countries where the projects took place in.

The political atmosphere is directly correlated to the financial atmosphere. However, beyond that, the political atmosphere dictates day to day life as well as legal regulations. A problematic political environment (e.g. terrorism, civil war), can seriously compromise resource management and on-site mood of the workers. Many contractors faced with serious problems with the governments in some countries due to political instabilities. It can lead to long periods of international legal problems, leaving the contractor in severe financial damage.

While the **Force Majeure** releases all involved parties from legal responsibility, the financial and time loss of such a disaster cannot be overlooked. Furthermore, if one or more project is affected as such, it influences the success of the portfolio as well. Therefore, the participants were asked to evaluate the effects of Force Majeure events on the projects.

3.2.5. Portfolio Related Factors

Alongside all the project related factors, there are factors that are directly related to the portfolio itself. Participants were asked to evaluate portfolio related factors from "did not meet expectations" to "exceeds expectations". They were also presented with the option of "I do not have information". This group consisted of four factors.

Financial resource transfer is not uncommon in the construction industry due to the industry's very nature of being project-based and having cash flow fluctuations. Although it's important to assess cash planning inside the project, it is also important to have the flexibility to transfer financial resources in a smart manner that will benefit the overall portfolio. Therefore, participants were asked if the financial resource transfers were satisfactory or not.

Like the financial resource transfer, **human resource transfer** plays a similar role. In a time of need or unexpected circumstances, human resources of various experience levels and capabilities may need to be transferred in between projects to optimize the portfolio success.

Similar to the first two factors related to portfolio success, due to maintenance, resource planning, periodic needs or unexpected circumstances **machinery and equipment transfer** might be needed in between projects. The lack of strategic transfer between projects might affect a core performance indicator which is time management.

Literature shows project portfolio management to be feasible and beneficial to the construction industry and to contractors of various size and expertise. Portfolio management by definition is directly linked to the strategic goals of the companies. As a result, in order to benefit from portfolio management, in other words for the portfolio to be successful, the companies need to approach the portfolio from this point

of view. Therefore, the participants were asked to evaluate the companies' perception regarding the **strategic importance of the portfolio.**

3.3. Participants' Profile

22 participants from the construction industry took part in the survey and evaluated 22 portfolios consisting of 73 projects according to the factors which were presented to them. Since the participants were from the construction industry, as seen in Figure 3.1, most of the participants were civil engineers.

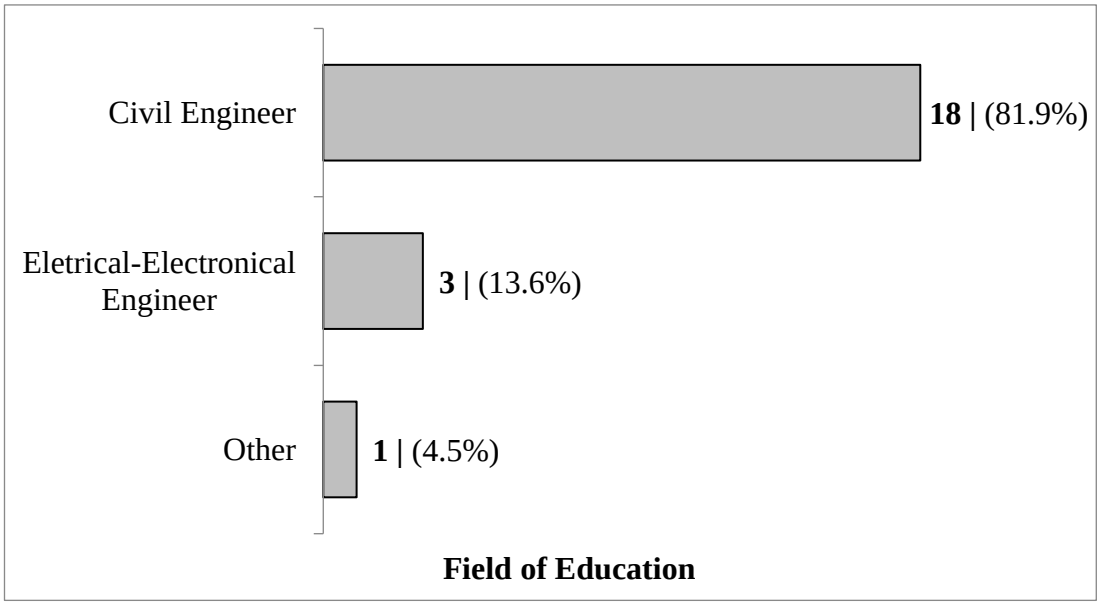

Figure 3.1. Educational Backgrounds of the Survey Participants

About two-thirds of the survey participants have bachelor's degrees as their education level. Six of the participants hold master's degree and one of the participants hold a Ph.D. (See Figure 3.2).

The professional experience level of the participants has a wide range. As stated in Figure 3.3, roughly half of the participants have over 20 years of experience in the construction industry.

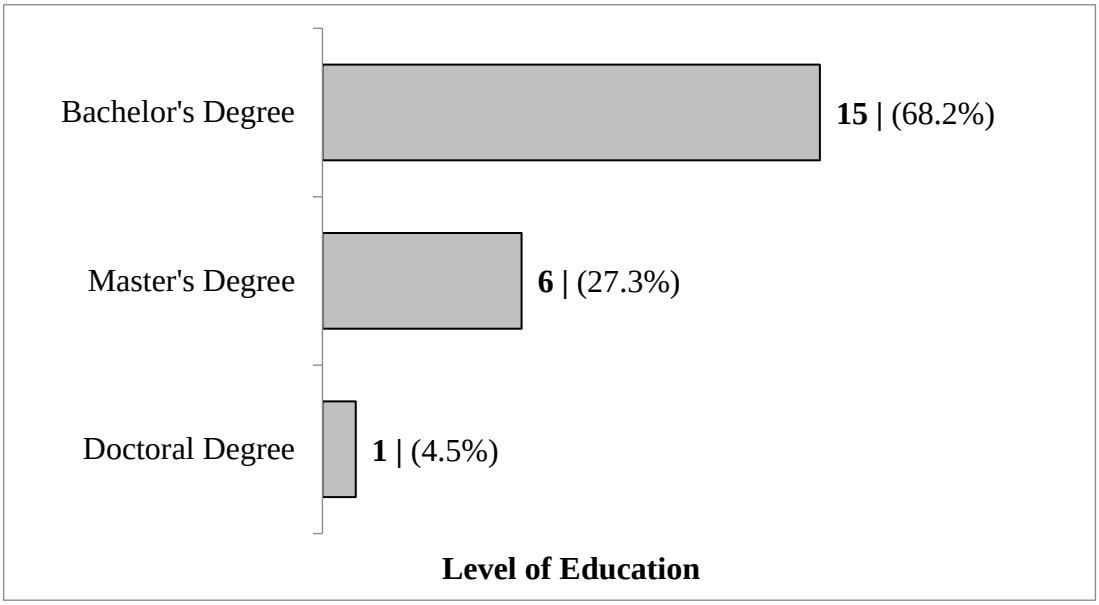

Figure 3.2. Education Levels of the Survey Participants

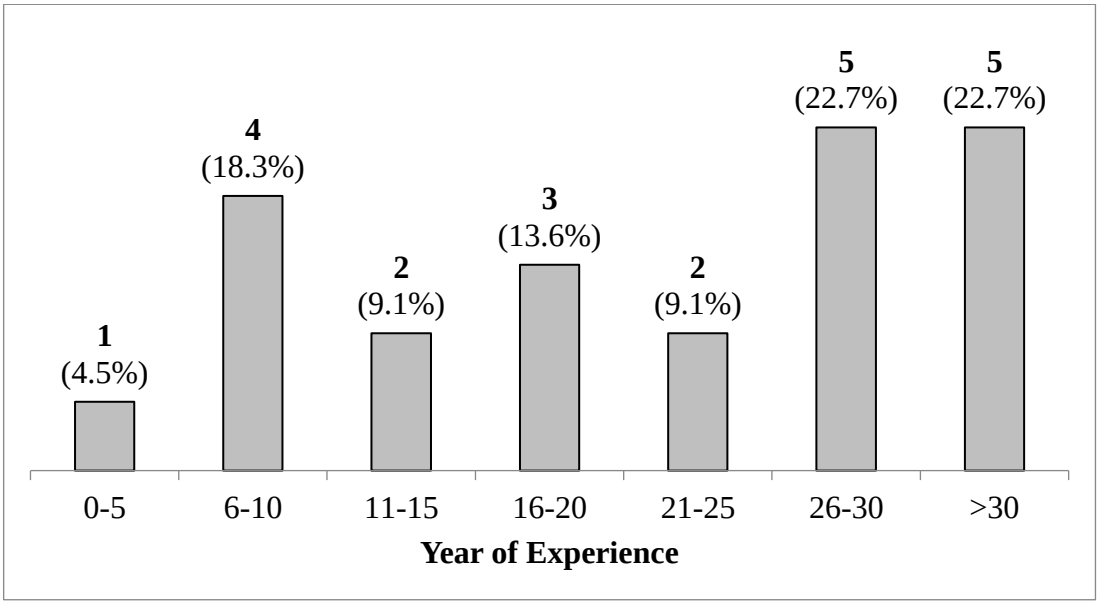

Figure 3.3. Experience Levels of the Survey Participants

Figure 3.4 presents the distribution of project types in which participants took place in their professional lives. Participants took place mostly in infrastructure projects closely followed by superstructure projects. Energy and industrial projects come after these two.

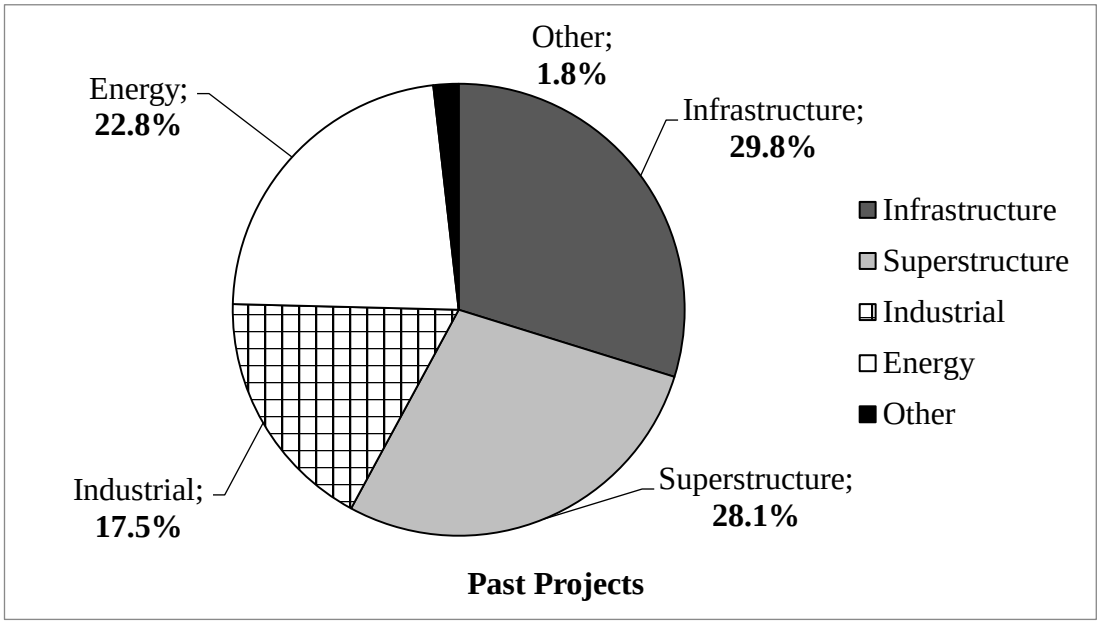

Figure 3.4. Participated Project Types of the Survey Participants

54.5% of the survey participants have worked in single country during their professional careers (See Figure 3.5). The other 45.5%, on the other hand, have worked in more than one country.

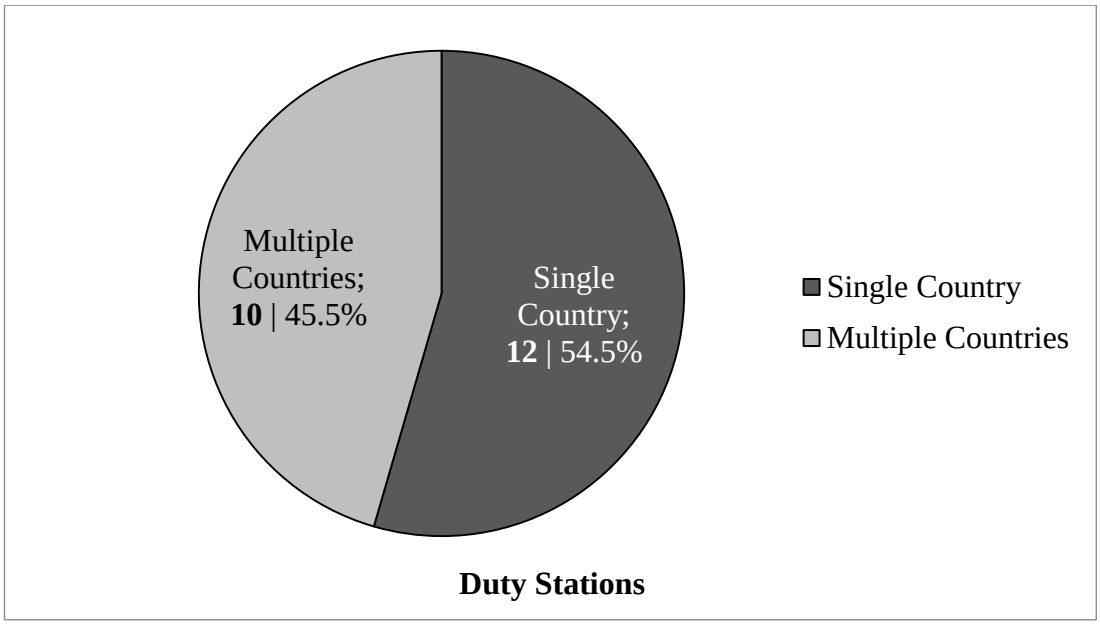

Figure 3.5. Duty Stations of the Survey Participants

As stated before, more than half of the participants have over 20 years of professional experience. Similarly, 54.5% of the participants have previously worked as a project manager in a construction project (See Figure 3.6).

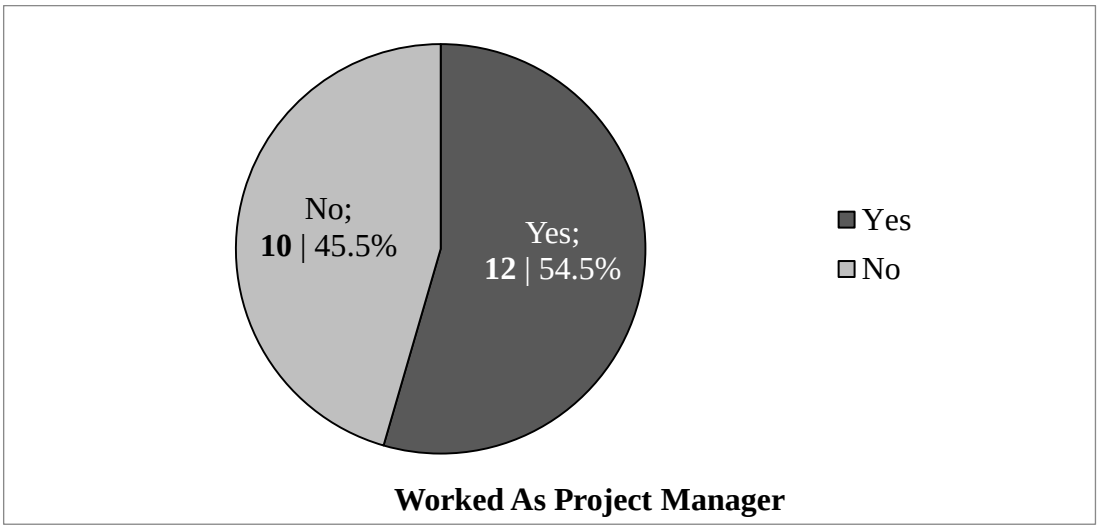

Figure 3.6. The Survey Participants Who Has Worked as Project Manager

In addition, as shown in Figure 3.7**Error! Reference source not found.**, 36.4% of the survey participants have previously worked as a portfolio manager in construction industry.

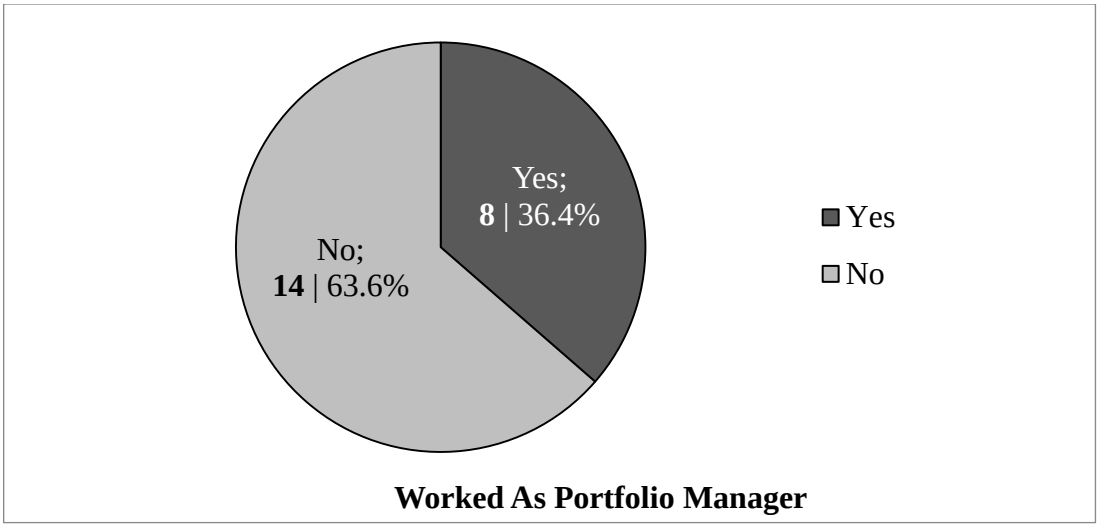

Figure 3.7. The Survey Participants Who Has Worked as Portfolio Manager

3.4. Evaluated Portfolios' and Projects' Profile

Survey data consists of information related to 22 portfolios and 73 projects with different types, sizes, locations, clients and many other criteria. %52.2 of the 73 projects have taken place in Turkey and 47.8% took place abroad (See Figure 3.8). Among the projects which were carried at abroad, Russia comes first with 8 projects.

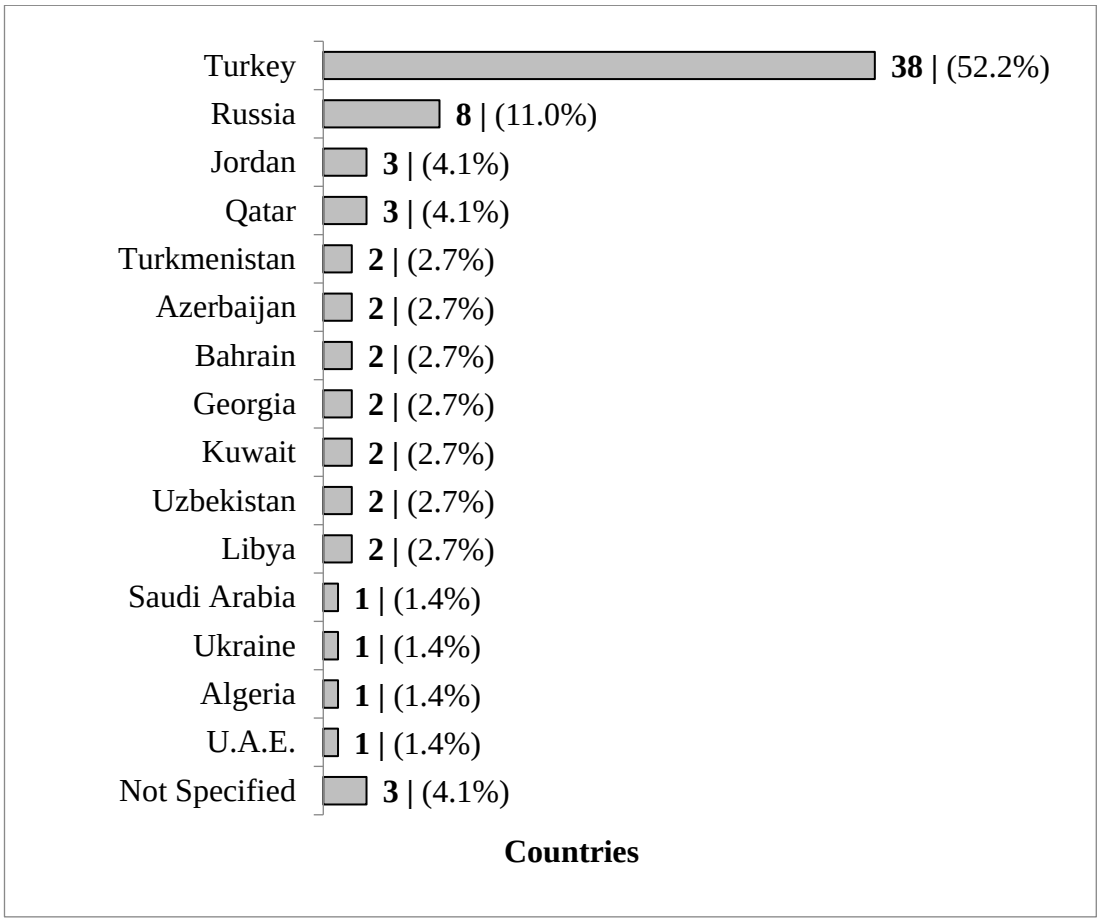

Figure 3.8. Locations of the Projects

Client distribution of the projects are given in Figure 3.9, and private sector projects spearhead by 46.6%. Governmental projects follow the private sector with 35.6% and 15.1% of the projects are investments of the contractors themselves.

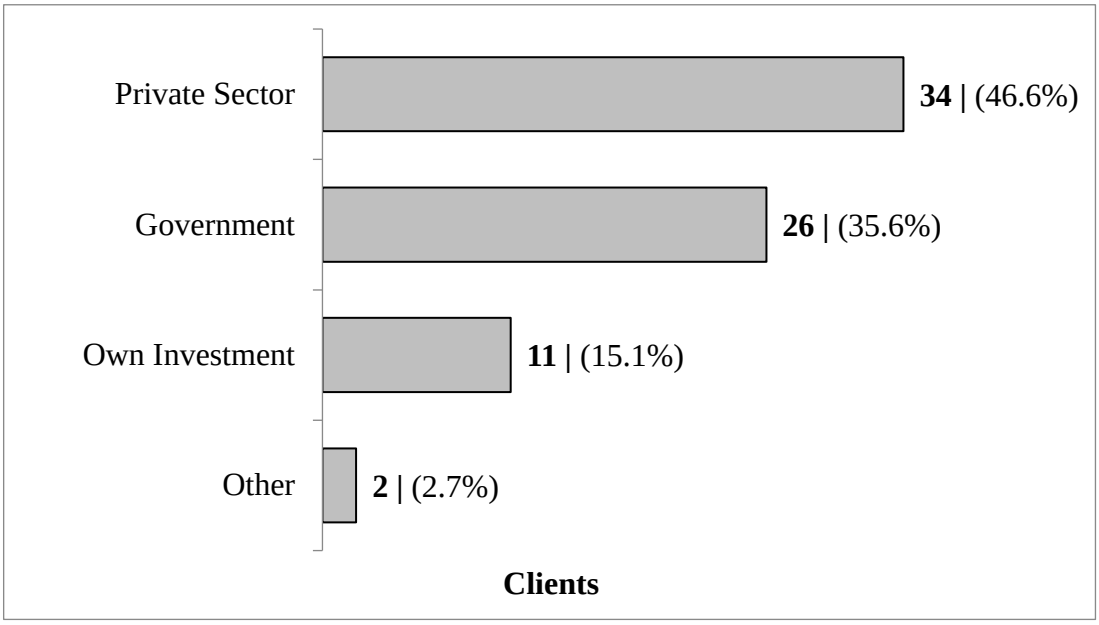

Figure 3.9. Clients of the Projects

As seen in Figure 3.10, when we look at the type of projects that were evaluated, superstructure projects are leading by far with 37.1%. Infrastructure, energy and industrial projects are all close in ratio to another, which are around 20%.

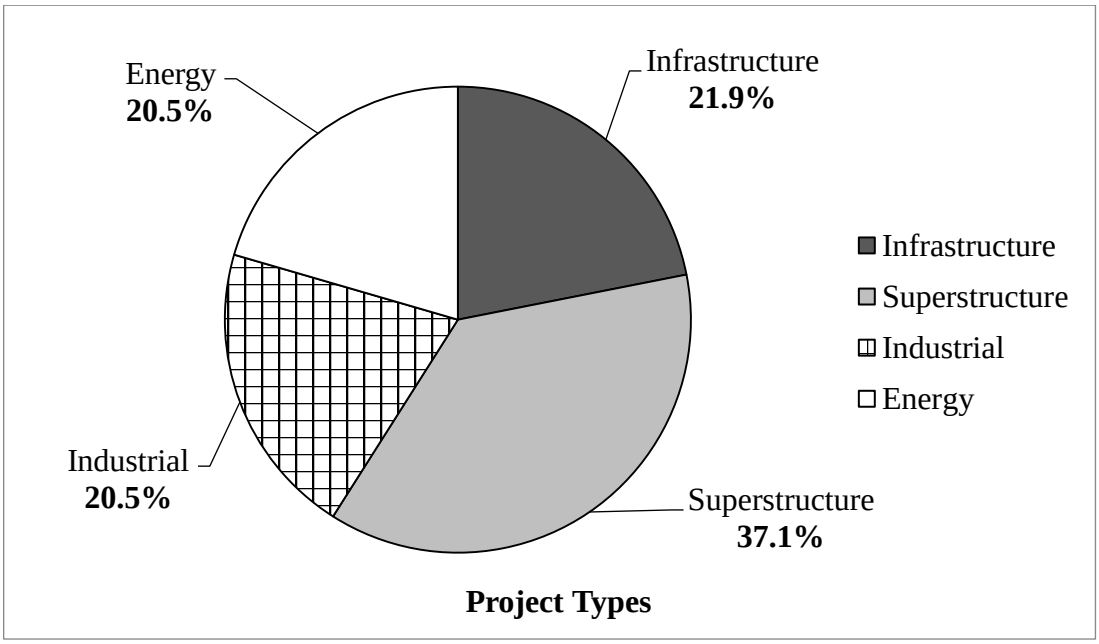

Figure 3.10. Project Types

When we take a look at the scope of the projects, we see that most of the projects are contracted as design and build projects (See Figure 3.11).

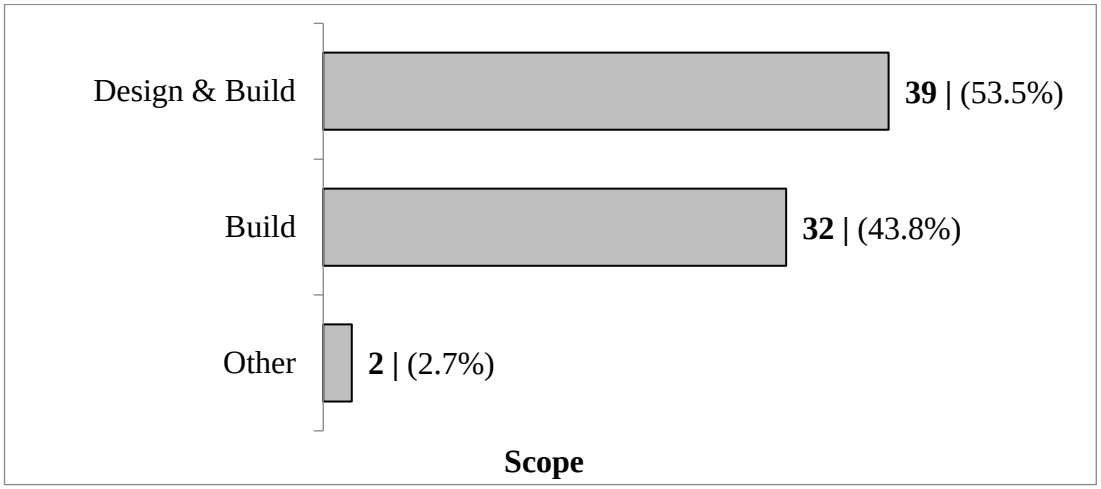

Figure 3.11. Scope of the Projects

When evaluated by the contract type, a big chunk of the 73 projects (61.6%) that were being surveyed emerge to be turnkey contracts. As seen in Figure 3.12, turnkey is followed respectively by unit price, cost plus fee and mixed contracts.

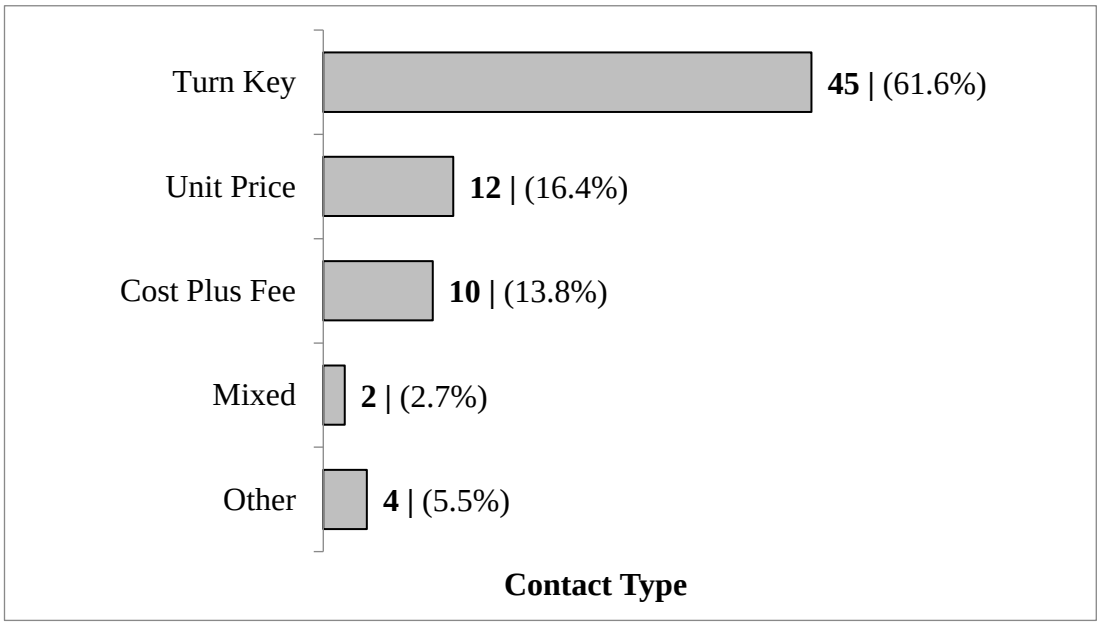

Figure 3.12. Contract Types of the Projects

Figure 3.13 shows the contract values of the projects that were being evaluated. Roughly half of the projects have a contract value of above 100 Million USD and 27.4% have their contract value set at more than 500 Million USD.

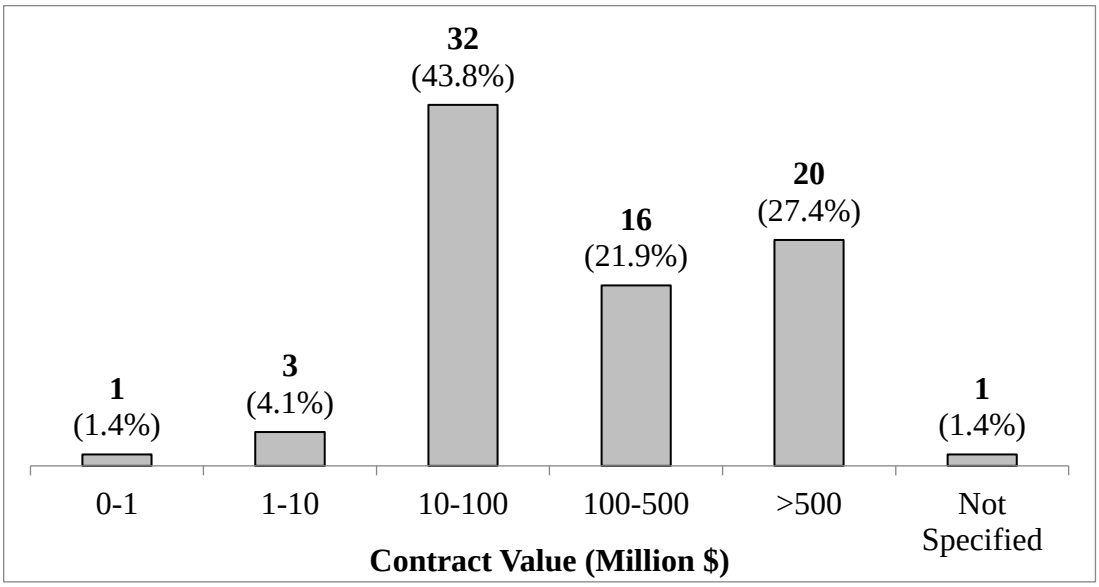

Figure 3.13. Contract Values of the Projects

The projects can be considered lengthy due to their duration. Majority of the projects (42.5%) have the duration between 25 to 36 months (See Figure 3.14).

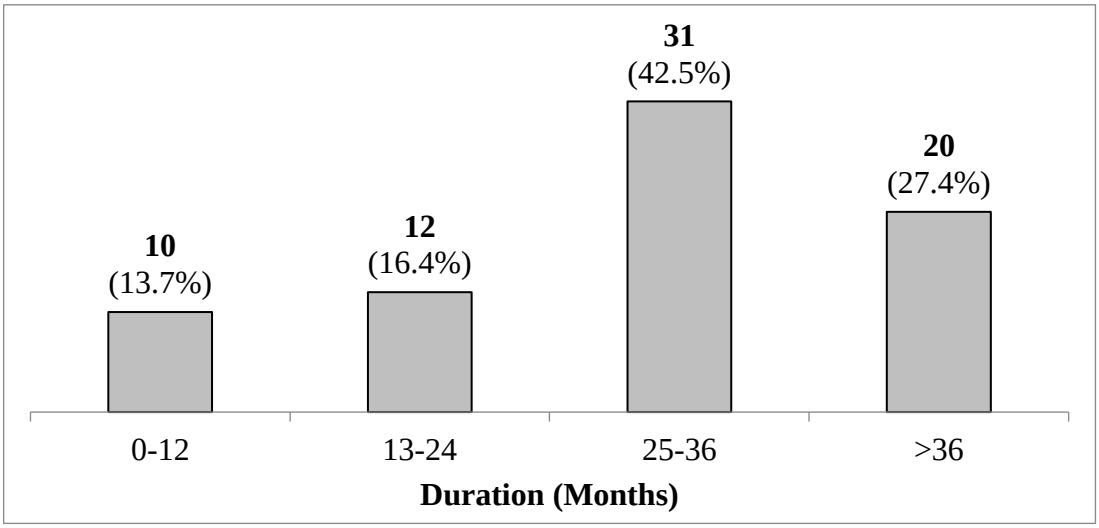

Figure 3.14. Durations of the Projects

As seen in Figure 3.15, most of the portfolios which were being evaluated have 2 to 3 projects in them (81.9%). Two portfolios hold 4 to 5 projects and only two of the portfolios contain 10 projects (2.7%).

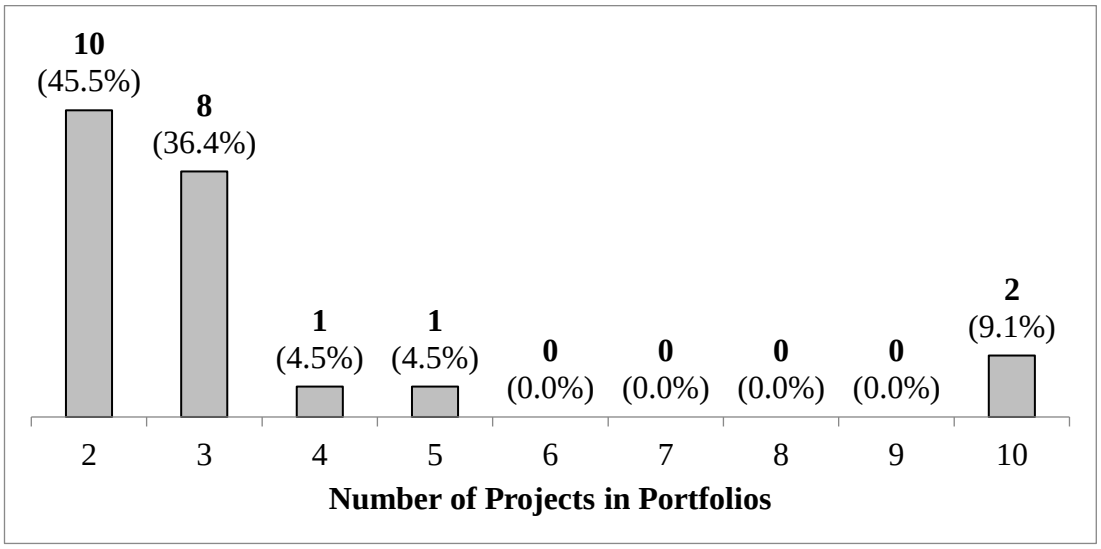

Figure 3.15. Number of Projects in Portfolios

When the success of the projects is evaluated, the participants found 56 of the 73 projects (76.7%) to be successful (See Figure 3.16).

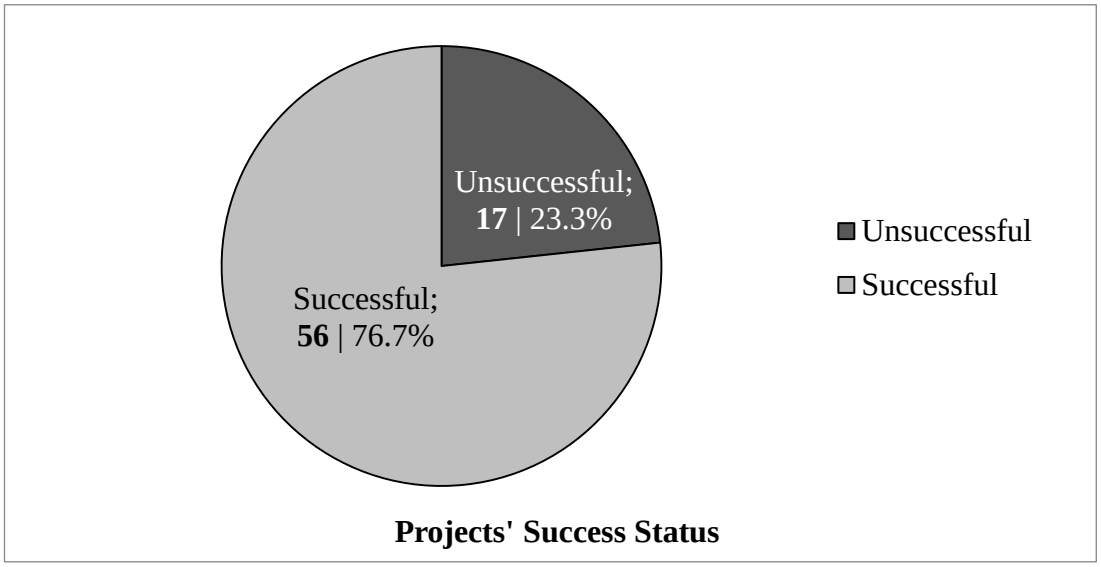

Figure 3.16. Success Status of the Projects

When the success of the 22 portfolios is surveyed, the participants stated they have found 77.3% of the portfolios successful (See Figure 3.17).

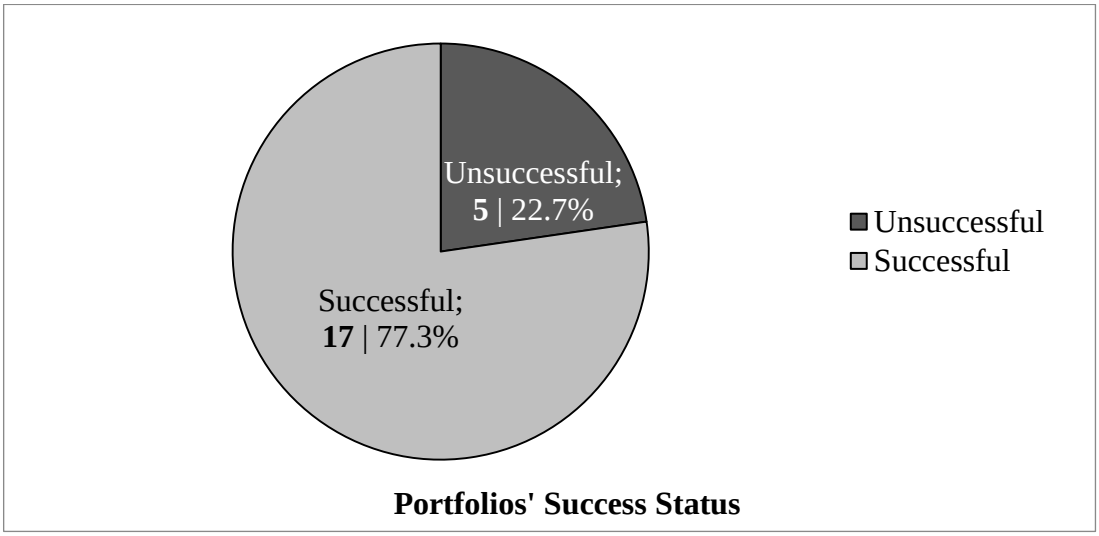

Figure 3.17. Success Status of the Portfolios

CHAPTER 4

ANALYSIS AND RESULTS

4.1. Methodology

For the analysis of project and portfolio data, several statistical methods have been used. In the scope of this study, participants have evaluated the projects and portfolios in terms of both numerical and categorical factors and then they decided whether the projects/portfolios were successful or not.

In the first part of the analysis, **categorical factors** such as client, tender, project delivery, contract types were investigated. By this means, general success trends of projects and portfolios were observed.

The second part of the analysis focused on the **numerical factors** that were evaluated on the scale of 1-5. Numerical factors were categorized in four groups for the projects; named as project, company, human resources related and external factors. In addition to these four groups, portfolio related factors were added for the success evaluation of the portfolios and these five factor groups were considered in terms of portfolio success. For the analysis of these numerical factors, **T-Test** was conducted to show the determinant factors on the project and portfolio success.

The success factors were evaluated on a scale of 1-5 and resultant success level of the projects and portfolios were chosen as “successful” or “unsuccessful” by the participants. Since the outcome; which is success status, is measured with a dichotomous variable; **logistic regression** was chosen as the next analysis method. By using logistic regression, a model was obtained to predict success probability of the portfolios. SPSS 24 software was used to construct a logistic regression model. After

logistic regression, **five-fold cross validation** was performed to further analyze the predictive power of the regression model.

In the final part, a **sensitivity analysis** was conducted for the logistic regression model. With the help of sensitivity analysis, the effect of changes in the independent variables on the outcome of regression model was examined. In the following sections, results of each of the analysis methods are presented.

4.2. Project and Portfolio Success

In the scope of our study, 22 portfolios that contains 73 projects were evaluated by the construction professionals. In order to show the success trends in our data set, categorical factors such as client, tender, delivery types are visualized.

Figure 4.1. Client Types and Project Success

As it can be seen in Figure 4.1, projects which are owned by private sector and projects that are contractor's own investments showed better performance than governmental projects. Success rate is around 80% for private sector and investment projects; while it is around 60% for governmental projects.

Figure 4.2 shows that all the 10 projects in our data set that have negotiated tender type were successful. Success rates of the projects that have restricted, and open bid tender type were relatively lower.

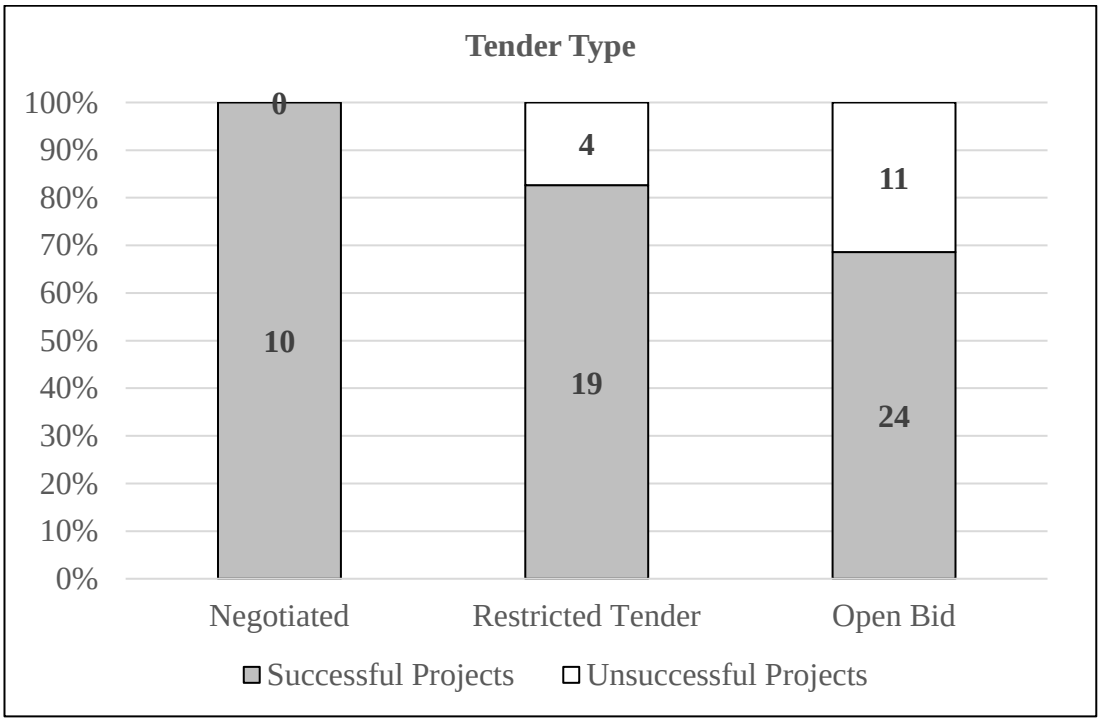

Figure 4.2. Tender Types and Project Success

Energy and superstructure projects in our data set appeared to show higher performance compared to industrial and infrastructure projects (See Figure 4.3).

Considering the project delivery types, it can be seen that almost 90% of the design and build projects were successful in our data set, while success rate drops to 60% for build projects (See Figure 4.4).

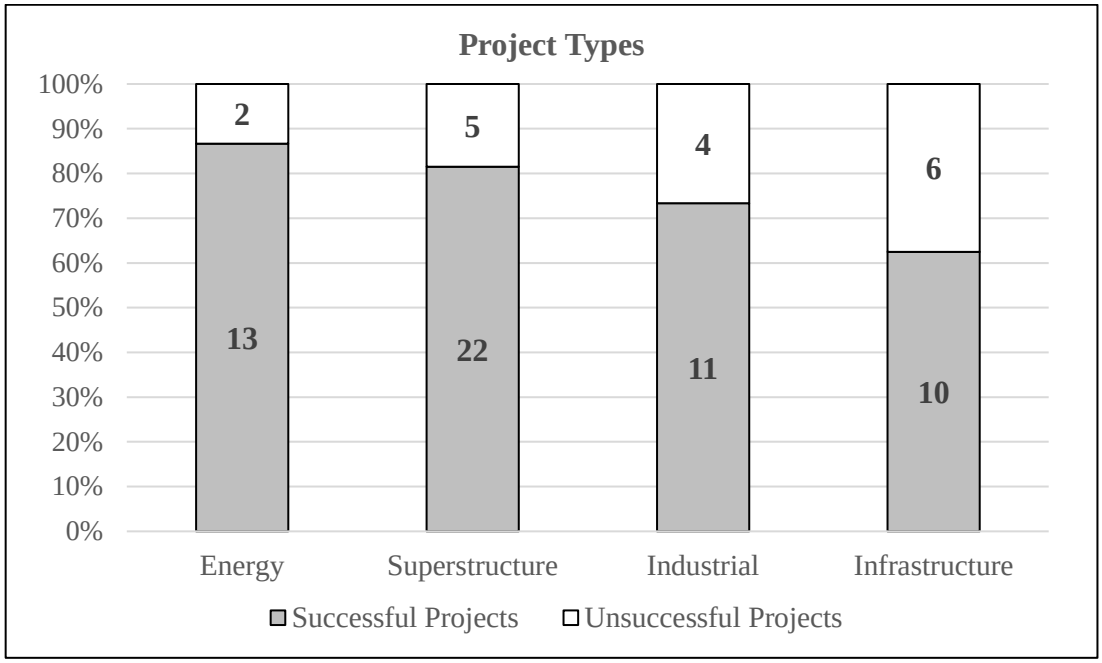

Figure 4.3. Project Types and Project Success

Figure 4.5 shows that all of the cost-plus fee projects in our data set emerged as successful, which are followed by unit price, turn key and mixed contract projects.

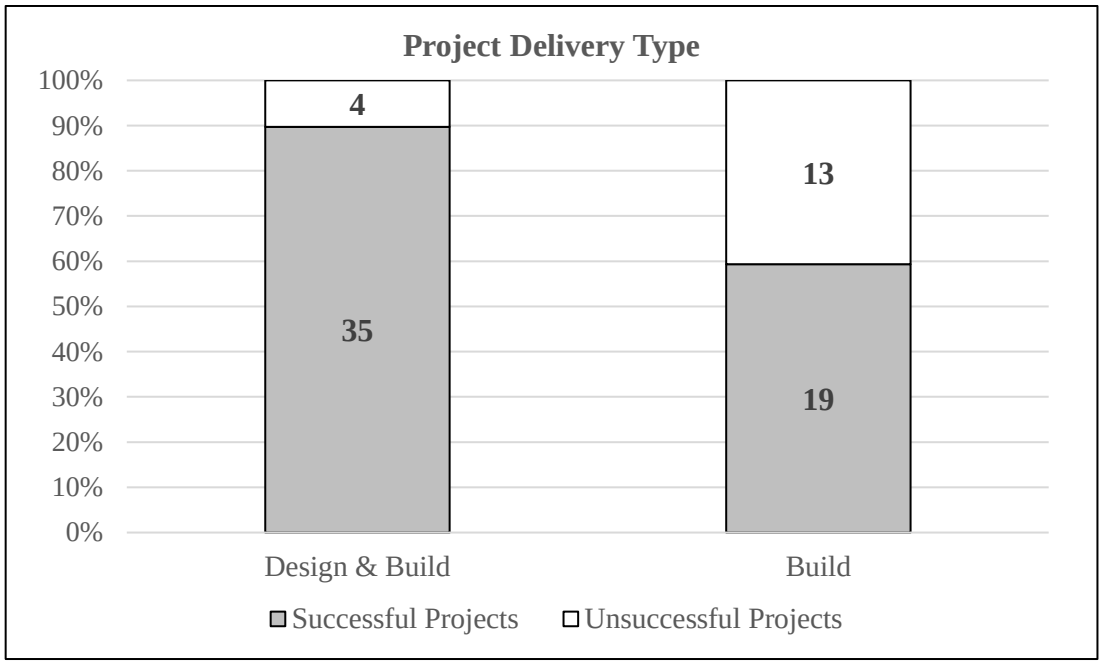

Figure 4.4. Delivery Types and Project Success

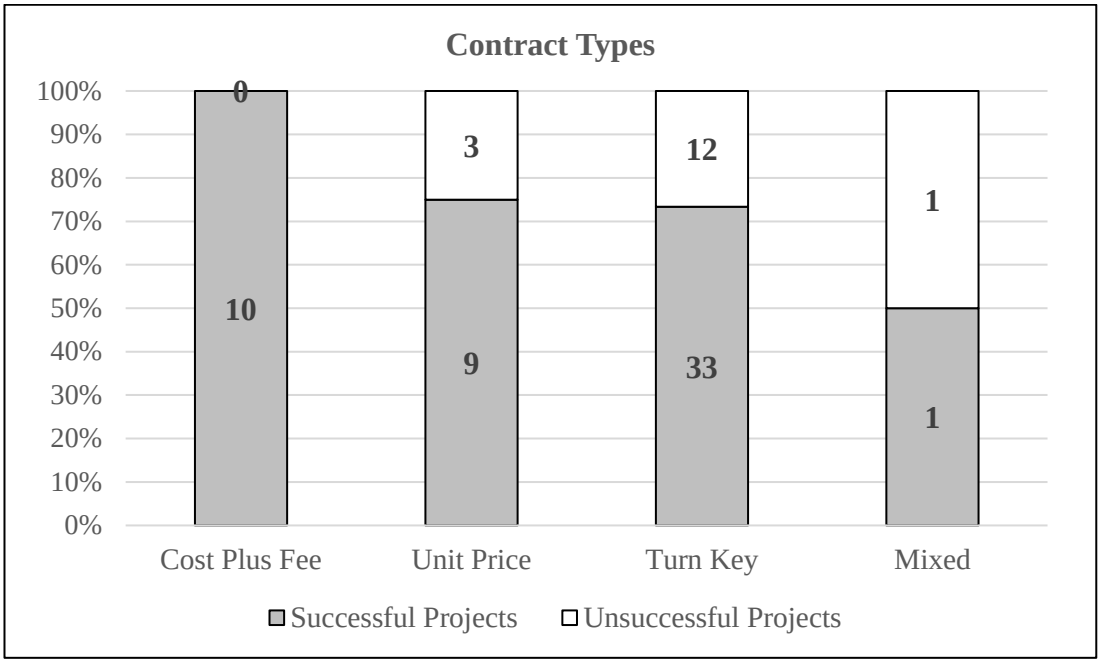

Figure 4.5. Contract Types and Project Success

Projects that are contracted by joint ventures showed lower performance than single company and consortium contracted projects (See Figure 4.6).

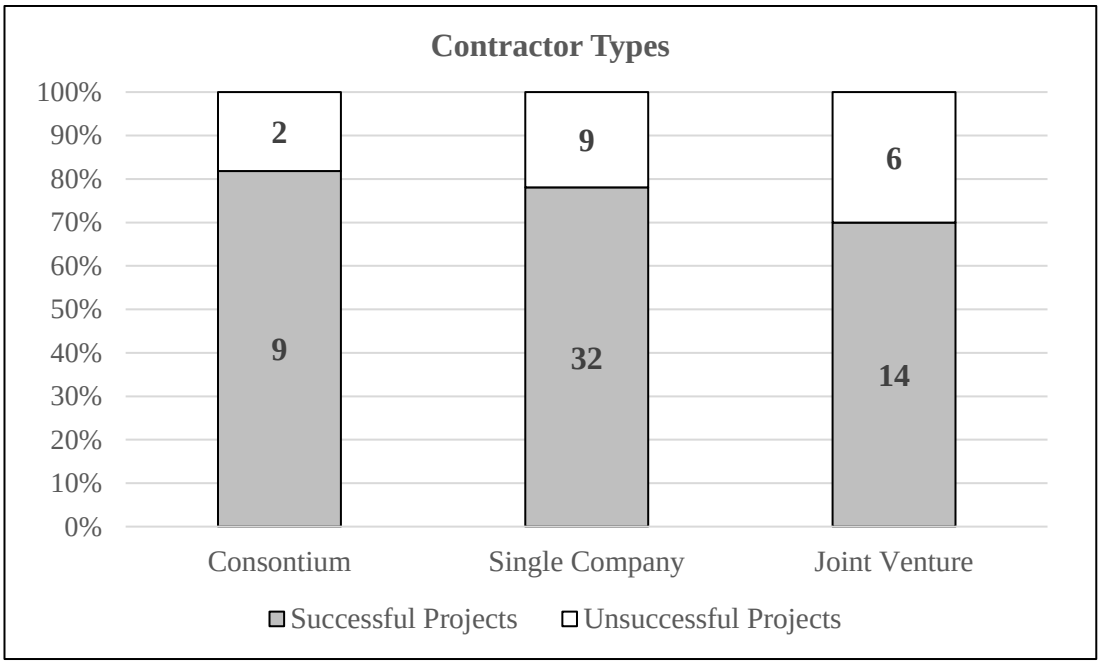

Figure 4.6. Contractor Types and Project Success

Contract value distribution and success status of the projects in our data set are presented in Figure 4.7. All of the projects that have contract value less than 10 million USD appeared to be successful, but it is worthy to note that there are only 4 projects with contract value less than 10 million USD in our data set, which contains total of 73 projects.

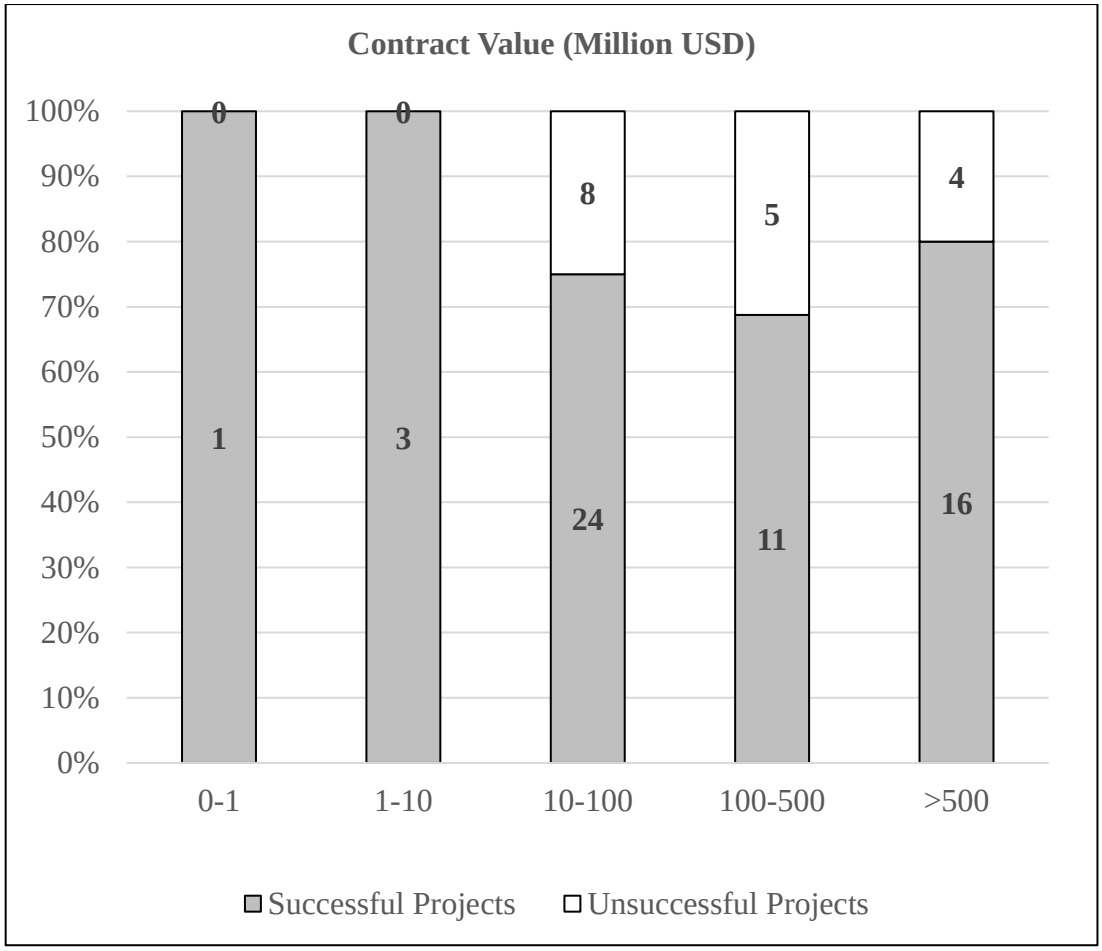

Figure 4.7. Contract Value and Project Success

Contract duration is another categorical factor that was analyzed in our survey and data analysis. The most successful projects in our data set had 0-12 months of project duration (See Figure 4.8). All the projects belonging that group were successful. It is followed by the projects that had project duration longer than 36 months for which the success rate was 80%.

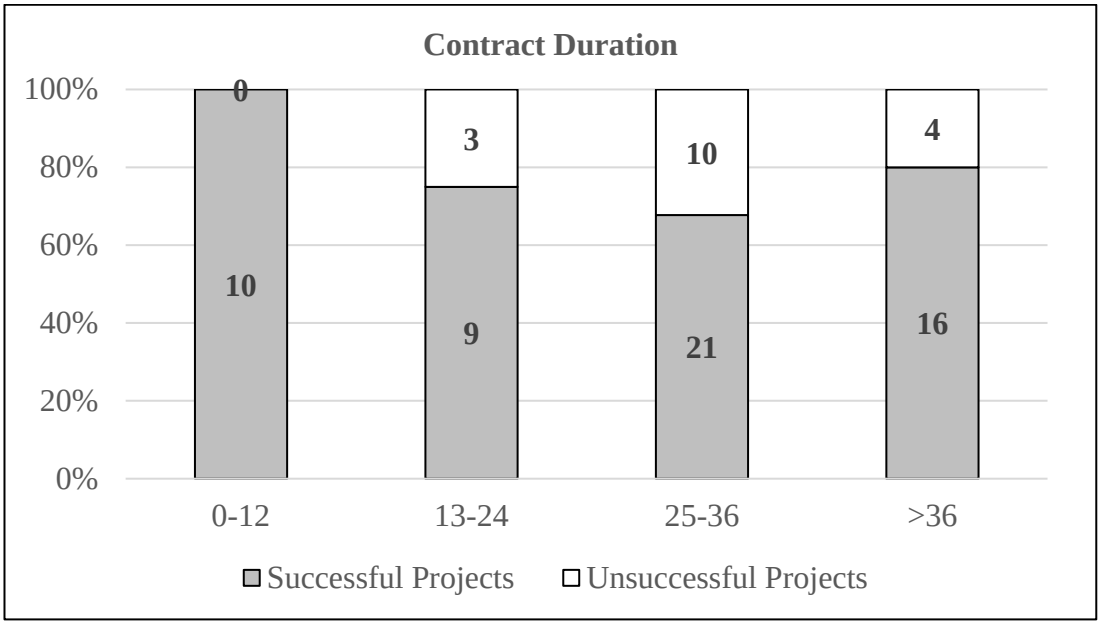

Figure 4.8. Contract Duration and Project Success

Additional works are inevitable for most of the construction projects. Additional work percentages that are presented in Figure 4.9 were calculated relative to initial contract value of the projects and the best performing projects belong to the group that has additional work percentage more than 20%.

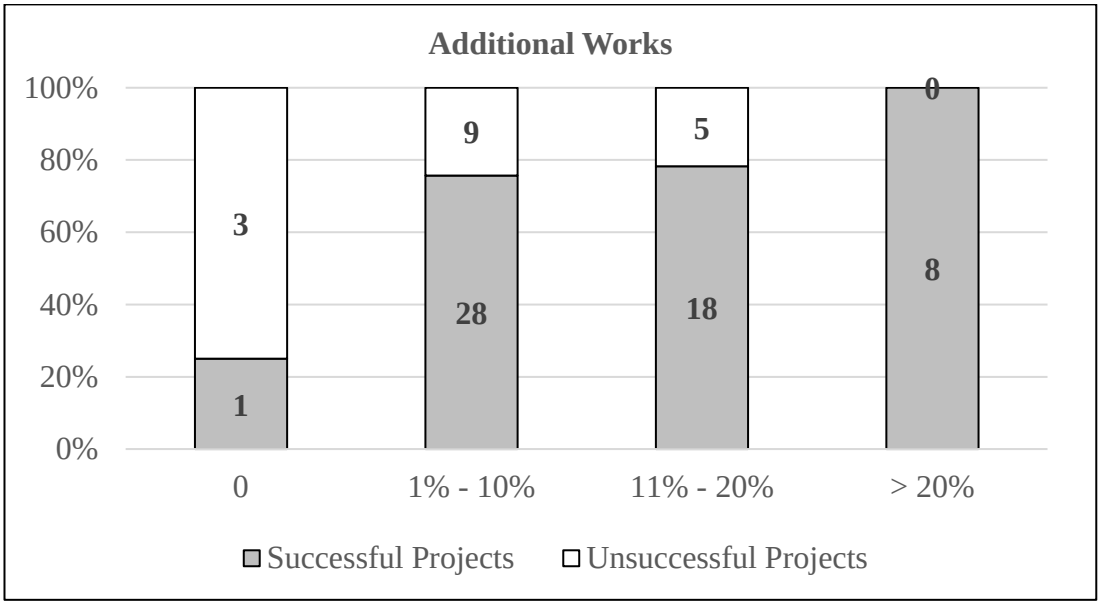

Figure 4.9. Additional Work Percentage and Project Success

The last categorical factor for project success was location. In terms of project location, two alternatives were presented to participants of the survey. 82.6% of the projects that were located outside of Turkey were successful projects, while this rate drops to 71.0% for the projects located in Turkey (See Figure 4.10).

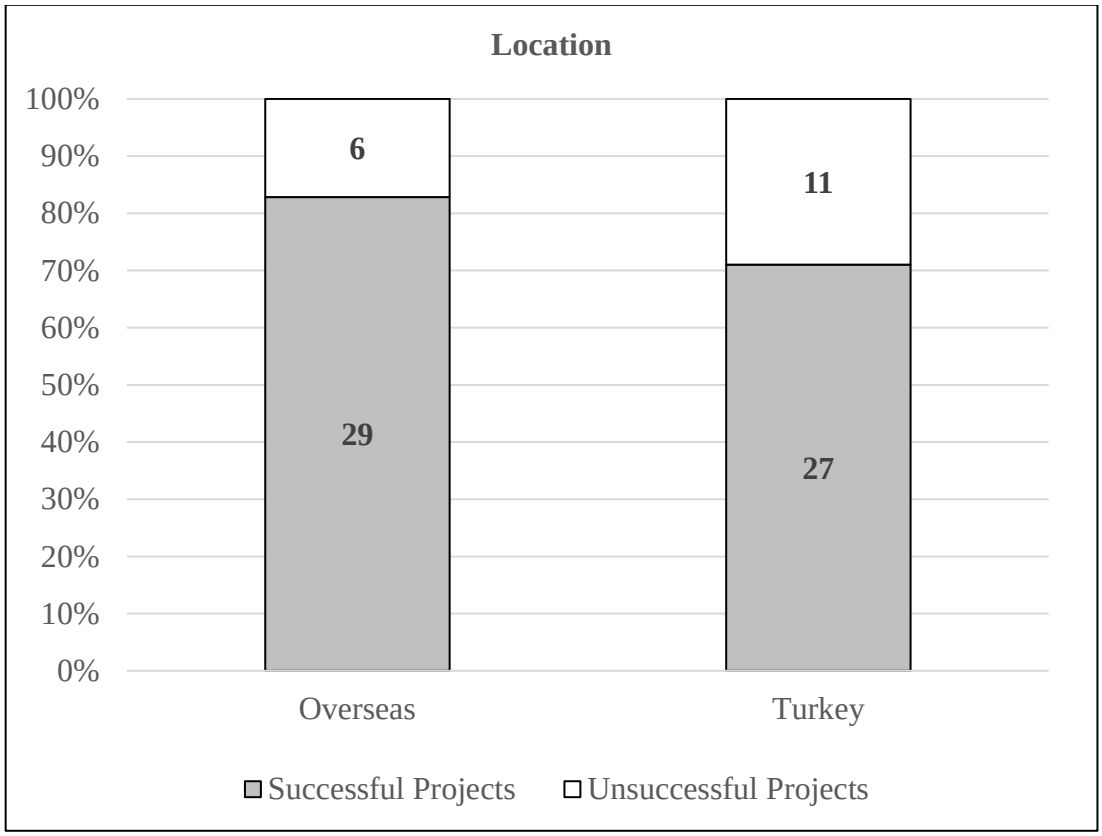

Figure 4.10. Project Location and Project Success

All of the given projects form 22 portfolios and each portfolio had 2 to 10 projects. When we consider 17 successful portfolios, we see that 11 of them had 100% project success (See Figure 4.11). 3 successful portfolios had 66.7% and remaining 3 successful portfolios had 50.0% project success.

As it can be seen in Figure 4.12, from the unsuccessful 5 portfolio's perspective, 3 of them had 50.0% project success rate and remaining 2 unsuccessful portfolios had 33.3% project success.

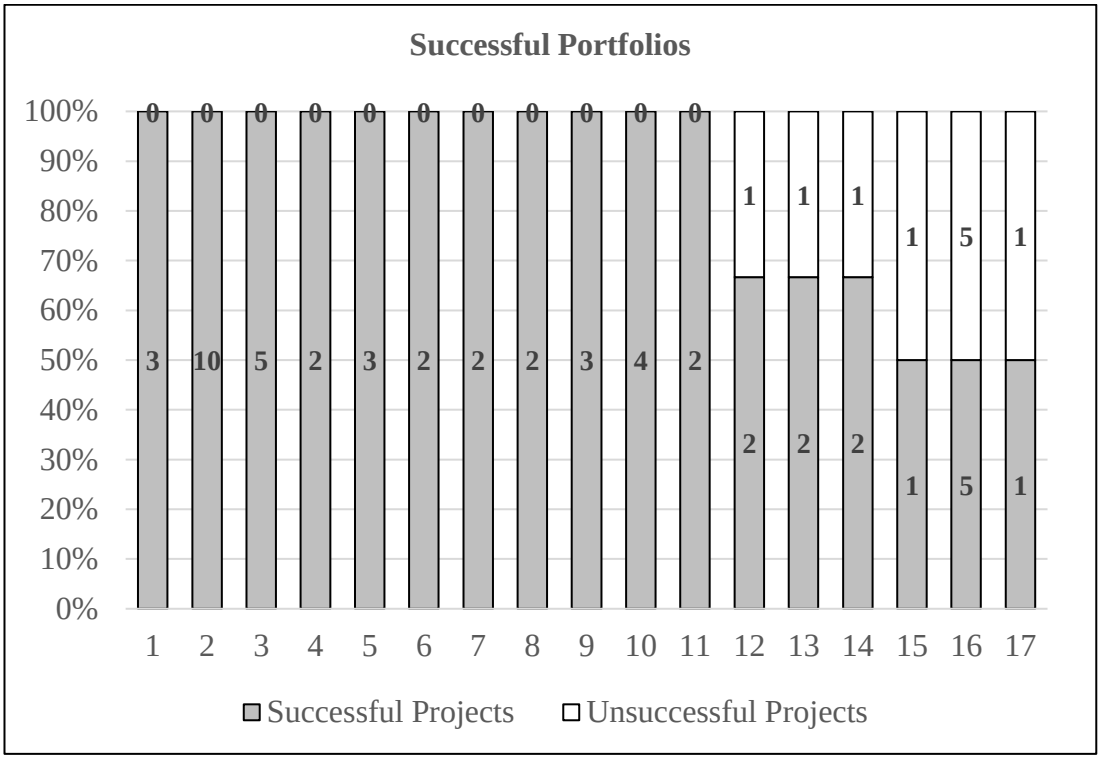

Figure 4.11. Project Success in Successful Portfolios

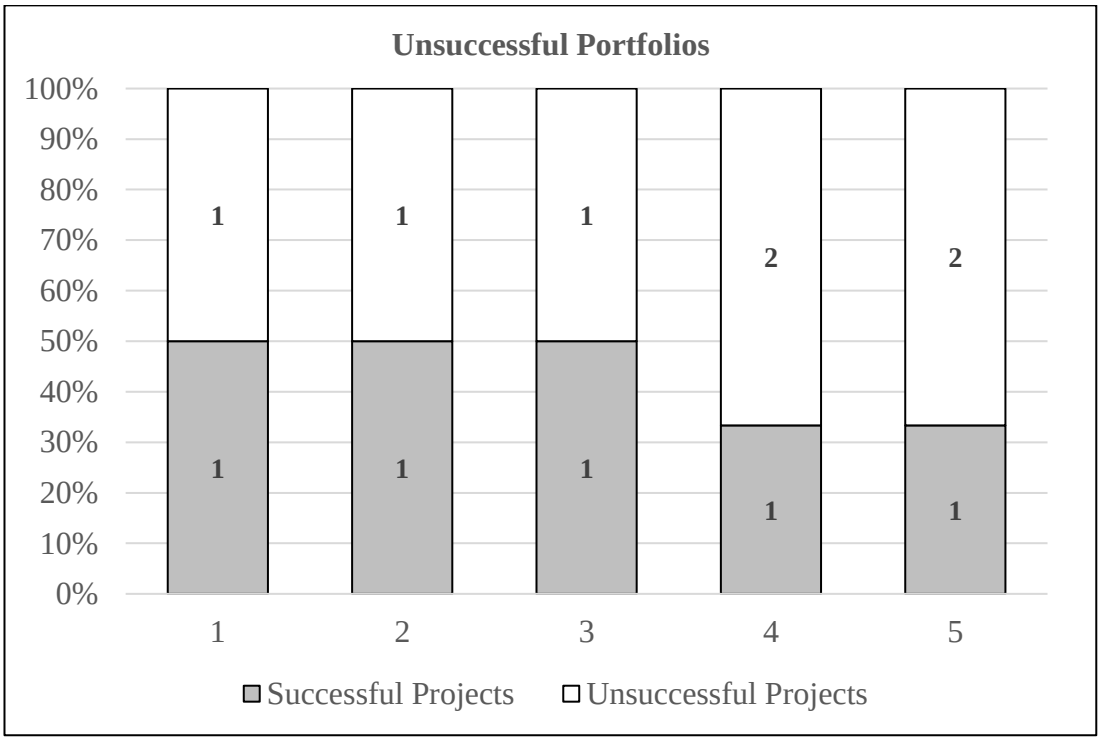

Figure 4.12. Project Success in Unsuccessful Portfolios

4.3. T-Test

In this study, 19 numerical factors were presented to participants regarding projects. In addition to these 19 factors, 6 more numerical factors were added for portfolios. Finally, "*number of projects*" and "*projects' success level*" were investigated as other numerical factors for the portfolio success.

In order to determine the determinant factors on project and portfolio success, T-test is performed on the projects and portfolios data sets. T-test is an inferential statistical method which is used to determine if there is a significant difference between the means of two groups. There are many statistical tests for the purpose of hypothesis testing and t-test is one of them. T-test requires three key inputs; mean values, standard deviations and the number of data values of each group. T-test assumes a null hypothesis that the means of the two groups are equal.

For our study, we have collected the data of 22 portfolios which contains 73 projects. Each project and portfolio were evaluated in terms of success factors and regarded as successful or unsuccessful by our participants. In order to conduct T-test, projects and portfolios were divided into two groups: successful and unsuccessful ones. Since the number of samples in each group is different, and the variance of the two data sets (for projects and portfolios, successively) is also different, Unequal Variance T-Test is selected as the analysis method. The following formulas are used for calculating t−value and degrees of freedom for the unequal variance T-test and T-Table is used to determine the critical t-values for different probability levels, which is selected as 0.90 for our study.

$$t - value = \frac{Mean_1 - Mean_2}{\sqrt{\frac{Var_1^2}{n_1} + \frac{Var_2^2}{n_2}}} \tag{4.1}$$

$$Degrees\ of\ freedom = \frac{\left(\frac{Var_1^2}{n_1} + \frac{Var_2^2}{n_2}\right)^2}{\frac{\left(\frac{Var_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{Var_2^2}{n_2}\right)^2}{n_2 - 1}} \quad (4.2)$$

Where;

$Mean_1$, $Mean_2$: Average values of each of group
var_1, var_2 : Variance of each of group
n_1, n_2 : Number of records in each group

As the details could be seen on Table 4.1; 11 out of 19 factors for project success are found as significant at 0.90; named as "*18.Subcontractors*", "*19.Suppliers*", "*22.Contract Management*", "*23.Budget Target*", "*24.Duration Target*", "*28.Company's Financial Condition*", "*29.Managerial Processes*", "*30.Engineers' Technical Skills*", "*31.Engineers' Managerial Skills*", "*32.Project Manager's Technical Skills*" and "*33.Project Manager's Managerial Skills*".

On the other hand, "*32.Project Manager's Technical Skills*", "*33.Project Manager's Managerial Skills*", "*35.Portfolio Manager's Managerial Skills*", "*40.Financial Resource Transfer*" and "*42.Machinery & Equipment Transfer*" are found as significant factors for portfolio success at 0.90. In addition to that, "*projects' success level*" is found as significant for portfolio success; while "*number of projects*" is found as insignificant for portfolio success. Result of T-Test for the portfolios is given in Table 4.2.

Table 4.1. *T-Test Results of Projects*

PROJECTS | T-TEST		Mean of Successful	Mean of Unsuccessful	t-Stat
PROJECT	**18.Subcontractors**	3.64	3.12	1.94
	19.Suppliers	3.81	3.06	2.63
	20.Financing	3.91	3.41	1.55
	21.Design	3.42	3.18	0.91
	22.Contract Management	3.47	2.76	2.08
	23.Budget Target	3.98	2.59	4.03
	24.Duration Target	3.36	2.06	4.67
	25.Scope Target	3.91	3.65	1.41
COMPANY	**27.Company's Experience**	4.13	3.59	1.51
	28.Company's Financial Condition	4.05	3.41	2.58
	29.Managerial Processes	3.46	2.88	2.01
HUMAN RESOURCES	**30.Engineers' Technical Skills**	3.85	3.47	2.45
	31.Engineers' Managerial Skills	3.70	3.29	1.96
	32.Project Manager's Technical Skills	3.85	2.94	3.38
	33.Project Manager's Managerial Skills	3.51	2.82	2.28
EXTERNAL	**36.Location**	3.91	3.76	0.44
	37.Country's Economic Situation	2.85	3.24	-1.72
	38.Country's Political Atmosphere	2.61	3.12	-2.56
	39.Force Majeure	4.32	4.47	-0.48

Significant at 0.90

Insignificant

Table 4.2. *T-Test Results of Portfolios*

PORTFOLIOS | T-TEST		Mean of Successful	Mean of Unsuccessful	t-Stat
PROJECT	**18.Subcontractors**	3.54	3.53	0.03
	19.Suppliers	3.65	3.57	0.26
	20.Financing	3.78	3.83	-0.11
	21.Design	3.21	3.33	-0.29
	22.Contract Management	3.36	3.43	-0.22
	23.Budget Target	3.69	3.00	1.18
	24.Duration Target	3.21	2.60	1.44
	25.Scope Target	3.78	4.03	-0.69
COMPANY	**27.Company's Experience**	3.79	3.80	-0.04
	28.Company's Financial Condition	3.93	3.77	0.86
	29.Managerial Processes	3.25	3.13	0.42
HUMAN RESOURCES	**30.Engineers' Technical Skills**	3.86	3.50	1.36
	31.Engineers' Managerial Skills	3.66	3.20	1.23
	32.Project Manager's Technical Skills	3.81	3.07	2.74
	33.Project Manager's Managerial Skills	3.49	2.97	1.99
EXTERNAL	**36.Location**	3.79	3.97	-0.90
	37.Country's Economic Situation	2.94	3.43	-2.09
	38.Country's Political Atmosphere	2.66	3.37	-2.87
	39.Force Majeure	4.30	4.20	0.23
PORTFOLIO	**34.Portfolio Manager's Technical Skills**	4.00	3.00	1.76
	35.Portfolio Manager's Managerial Skills	3.71	2.25	3.55
	40.Financial Resource Transfer	3.50	2.75	2.86
	41.Human Resource Transfer	2.62	2.00	1.24
	42.Machinery & Equipment Transfer	2.92	1.80	2.76
	43.Portfolio's Strategic Importance	3.47	3.20	0.82
OTHER	**Number of Projects**	2.73	2.40	1.00
	Projects' Success Level	0.85	0.43	6.40

Significant at 0.90

Insignificant

Before deeply analyzing the results, it is worthy to note that project success shows a strong correlation with portfolio success; which is expectable. The term "success" has many definitions in literature, and it is discussed profoundly in "Literature Review" part of this study. However, to understand what portfolio success means for construction professionals, some open-ended questions were asked. When we comprehend the perception of the participants of the survey, we see that completion on budget, on time and client satisfaction are emerged as the most important aspects of portfolio success.

In order to optimize resource allocation within the portfolio, the construction professionals that took part in our survey study give most weight to the projects with highest contract value. In addition, project duration, delay penalties and power and/or interest of the client are observed as other critical factors in prioritization of the projects in the portfolios.

When comparing success probabilities of multiple portfolios, the fit between the company's experience and works under the scope of the portfolio appeared to be the most important factor from the perspective of our survey participants. On the other hand, T-Test results given in Table 4.1 and Table 4.2 show that "*27.Company's Experience*" is an insignificant factor for the success of both projects and portfolios according to our data set, which is an interesting finding of this study. In addition, portfolios that contain similar and nearly located projects considered to have higher chance of success according to survey participants.

Resource transfer is one of the key aspects of PPM, which helps to optimally allocate the resources between the projects. In some cases, portfolio managers need to make decisions about scarce resources and transfer the resources to critical projects at the cost of sacrificing some other projects. Majority of our construction professionals approve resource transfer between the projects to increase the overall success probability of the portfolio, but they have hesitations about sacrificing other projects

and emphasize importance of planning to minimize the negative effects of the resource transfer on the source project.

As stated previously, project success shows a strong correlation with portfolio success; which is expectable. Success rate of evaluated projects in our data set was 76.7%, which is very close to portfolios' success rate; 77.3%. Moreover, average project success in successful portfolios was 50.0% and above; which is 50.0% and below for unsuccessful portfolios. As a result, it is clear that even if there are many portfolio-related success factors, project success gives strong clues about the portfolio success.

When we further analyze the projects in our data set, we come to the inference that involvement of contractor especially in tender and design phases increases the chance of success of both project and portfolio. As stated in chapter 4.2, the projects which have "*negotiated*" tender type and "*design & build*" project delivery type are positively separated from other projects. In negotiated tenders, contractors get involved in the project before it starts; as a result, some of the possible future problems could be argued and solved before the project starts. Similarly, in "*design & build"* projects contractor could find faster, easier and/or cheaper solutions to prepare designs with constructability considerations.

There were ten projects in our data set with "*cost plus fee*" contract type and all of them were successful. Turn-key and unit price contracts are riskier than cost plus fee contracts for the contractors. As a result, due to lower cost risk, a higher success rate could be expected in cost plus fee contracts.

On the other hand, there were some interesting patterns in our data set in terms of project and portfolio success. For example, additional work generally implies lack of scope definition in tender documents preparation phase. Additional needs that appear after the signature of the contract increase the scope and affect the time, cost and quality targets of the projects. Additional works could be considered as success

inhibitor intuitively, but in our data set the opposite was observed. Chance of success of the projects increased as the additional works ratio (relative to initial contract value) increased. Again, this phenomenon could be related with the risk sharing between the client and the contractor. Providing that the cost of additional works that were not included in the contracted scope of the project is undertaken by the client, additional works would not hurt the project success. However, this may not be the case for all construction projects. It is important to state that our findings are limited to our data set.

After interpreting the perception of construction professionals and success trends in our data set, some key findings of T-Test of project success (see Table 4.1. T-Test Results of Projects
) could be listed as follows;

- Engineers' and project managers' technical skills found to have more significant effects on projects success than their managerial skills,
- None of the external factors has significant effect on project success,
- Efficiency of managerial processes of the contractor company does not have a significant effect on project success, which is compatible with the less corporate nature of construction industry compared to other big industries like manufacturing, banking or software industry,
- Company's financial condition found as a significant factor, while country's economic situation found as insignificant, which reflects the nature of construction project finance. If the contractor has a strong financial position, project could survive against the fluctuations in the country's economy.

Besides the factors related with the project success, which are implicitly linked to portfolio success, determinant factors of portfolio success are analyzed in Table 4.2. From that table, we could draw some inferences such as;

- ❖ Portfolio managers' managerial skills were found as significant, while technical skills of them were found as insignificant considering portfolio success.
- ❖ Majority of the portfolios (81.8%) in our data set had 2 or 3 projects and number of projects does not have a significant effect on portfolio success,
- ❖ Although the construction professionals who were participants of our survey had the perception that the fit between the portfolio's scope of works and company's experience is a determinant factor in portfolio success, T-Test shows that it is not a significant factor for our data set.

Transfer of resources is one of the key aspects of PPM, and both financial resource and machinery-equipment transfer were found as significant factors for portfolio success, whereas human resource transfer was not. Mobilization of money and/or machinery-equipment between projects are easier compared to personnel transfer, because people have a social life, family and responsibilities. As a result, especially long-term transfer of personnel between projects is less common compared to financial or machinery-equipment transfer.

4.4. Regression Analysis

Regression analysis is a mathematical function that shows the relationship between dependent and independent variables. In our study, since the dependent variable (success status of the portfolio) was dichotomous (successful or unsuccessful), logistic regression was chosen as the method for regression analysis.

For the logistic regression model of the portfolio success, five factors which were found significant in T-Test were used. The significant factors were "*32.Project Manager's Technical Skills*", "*33.Project Manager's Managerial Skills*", "*35.Portfolio Manager's Managerial Skills*", "*40.Financial Resource Transfer*" and "*42.Machinery & Equipment Transfer*".

The probability of success of a portfolio is defined by the logit function as follows;

$$Probability\ of\ success\ of\ a\ portfolio = \frac{e^{y}}{1 + e^{y}} \tag{4.3}$$

$$\begin{aligned} y = & -13.567 + 0.367\ x\ (Project\ Manager's\ Technical\ Skills) \\ & + 0.752\ x\ (Project\ Manager's\ Managerial\ Skills) \\ & + 1.014\ x\ (Portfolio\ Manager's\ Managerial\ Skills) \\ & + 1.559\ x\ (Financial\ Resource\ Transfer) \\ & + 1.052\ x\ (Machinery\ \&\ Equipment\ Transfer) \end{aligned}$$

The variables range in between 1-5 scale and values for a typical successful and unsuccessful portfolio in our data set (from construction professional's perspective), are as follows respectively;

1. Project Manager's Technical Skills (Successful: 3.81 Unsuccessful: 3.07)
2. Project Manager's Managerial Skills (Successful: 3.49 Unsuccessful: 2.97)
3. Portfolio Manager's Managerial Skills (Successful: 3.71 Unsuccessful: 2.25)
4. Financial Resource Transfer (Successful: 3.50 Unsuccessful: 2.75)
5. Machinery & Equipment Transfer (Successful: 2.92 Unsuccessful: 1.80)

SPSS 24 provides an output for logistic regression model named as Block 0 (beginning block), which gives the results of analysis when all the arguments are excluded. It actually provides the basis for later comparison with the model to which the arguments are added. After constructing the regression model, performance of Block 0 and model are compared to see whether the model predicts better than Block 0 or not.

Omnibus is a test that can be expressed as a goodness of fit test. It tests whether there is a significant difference between the results obtained in Block 0 and the Model. The hypotheses we have established for this test are:

- H_0: There is no significant difference between the Model and Block 0.
- H_1: There is a significant difference between the Model and Block 0.

As it can be seen in Table 4.3, significance level of the model was found as 0.031, which is less than 0.05. As a result, we could reject the null hypothesis and conclude that our model explains better than Block 0.

Table 4.3. *Omnibus Tests of Model Coefficients*

	Chi-square	df	Sig.
Model	12.331	5	0.031

Next, a fit test (Hosmer and Lemeshow) was applied to examine whether there is a significant difference between the predicted and the observed values. Our hypotheses for this analysis are as follows:

- H_0: There is no significant difference between the predicted and the observed values.
- H_1: There is a significant difference between the predicted and the observed values.

The results of Hosmer and Lemeshow Test are presented in Table 4.4 and it can be seen that the significance value (0.282) is greater than 0.05, which indicates that we could reject the hypothesis of H_1 and say that the model predictions do not differ from the observations.

Table 4.4. *Hosmer and Lemeshow Test*

Step	Chi-square	df	Sig.
1	9.757	8	0.282

The model's fit accuracy is presented in Table 4.5. Our model correctly classifies 83.3% of unsuccessful portfolios and 93.8% of the successful portfolios. In addition, 90.9% of all portfolios' success status were fitted correctly.

Table 4.5. *Classification Table*

		Predicted (%)		
		Unsuccessful	Successful	% Correct
Observed (%)	Unsuccessful	83.3	16.7	83.3
	Successful	6.3	93.8	93.8
	Overall Percentage (Weighted)			90.9

4.5. Cross Validation

In order to further analyze the predictive power of the regression model, a five-fold cross validation test was conducted. As shown in Figure 4.13, data set was split into 5 random groups, and in each step four groups were used for training and constructing the logistic regression model and remaining one group was used to test the regression model.

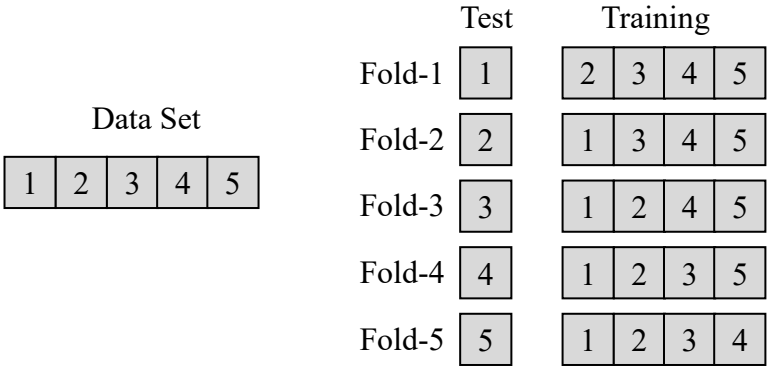

Figure 4.13. Five-Fold Cross Validation

After cycling this procedure for five times, 18 out of 22 portfolios were classified correctly and resultant predictive power found as 81.8%. Cross validation shows that our model correctly predicts the success status of 4 out of 5 portfolios. As a result,

predictive power of our model could be considered sufficient and its predictions are reasonable.

4.6. Sensitivity Analysis

After constructing a logistic regression model, a sensitivity analysis was conducted. Each five independent variables; named as "*32.Project Manager's Technical Skills*", "*33.Project Manager's Managerial Skills*", "*35.Portfolio Manager's Managerial Skills*", "*40.Financial Resource Transfer*" and "*42.Machinery & Equipment Transfer*", increased and decreased one-by-one, 35% incrementally and changes in the dependent variable (probability of portfolio success) was plotted in Figure 4.14. Interpretation of sensitivity analysis graph given in Figure 4.14 reveals that, portfolios are more sensitive to be affected negatively than positively. In other words, portfolios show a greater reaction when the performance of given parameters in the regression model drop than they increase. For example, for an average portfolio, 35% increase in financial transfer effectiveness increases the success probability of the portfolio by roughly 15%. Nevertheless, 35% performance loss in financial transfer effectiveness drops the success probability around 45%.

Besides these, comparison of independent variables in the regression model reveals that success probability of the portfolio is most sensitive to effectiveness of financial resource transfer. It is followed by portfolio manager's managerial skills, machinery-equipment transfer effectiveness, project manager's managerial skills and project manager's technical skills respectively. On average, effectiveness of financial resource transfer influences success probability of the portfolio 3-4 times more than project manager's technical skills and 1.5-2 times more than transfer of machinery-equipment.

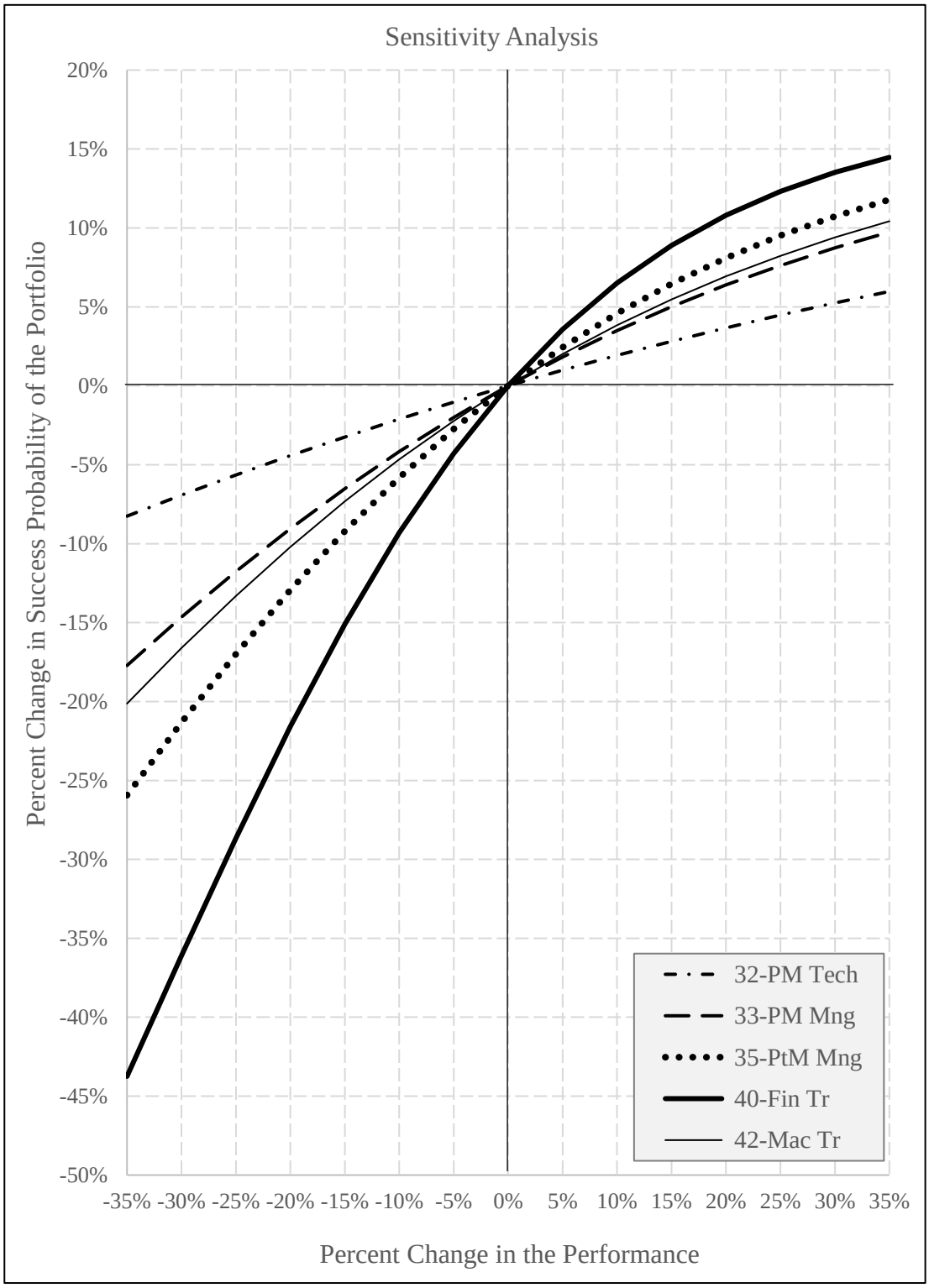

Figure 4.14. Results of Sensitivity Analysis

CHAPTER 5

CASE STUDIES

In addition to the project and portfolio data collection analysis and modeling that was performed within the thesis, in order to achieve a deeper analysis and examine real-life PPM examples from the construction industry, three case studies have been studied by landing face-to-face in-depth interviews. People and institutions participated in the case studies have been changed to fictional names to protect confidential business information and ensure anonymity.

5.1. First Case Study

5.1.1. Introduction

The subject of the first case study; Company XYZ, operates in superstructure projects as well as infrastructure and energy projects and has been active in the industry for over 50 years, predominantly in the Turkish market. For a very long time, Company XYZ has adopted a project-focused managerial style. However, with their increasing work volume and project variety, they have opted for reorganization within the company in 2014 and started preparations for bringing project portfolio management to life in their corporate identity. With these goals, they have grouped the projects in relation to their respective disciplines under three portfolios - superstructure, infrastructure, and energy.

The result of reconstruction, assignment of a project manager to every project to be working on the field and appointment of a portfolio manager to every portfolio were decided. These portfolio managers subordinate to an executive board consisting of other portfolio managers and general manager (See Figure 5.1).

The subject of the in-depth interview is Mr. Smith, who is a civil engineer with industry experience over 30 years. This professional has been working as a portfolio manager for 10 years having previously worked in different countries, in various positions ranging from site engineer to portfolio manager on many infrastructure projects. The professional has been working as an Infrastructure Portfolio Manager in Company XYZ for the last 5 years.

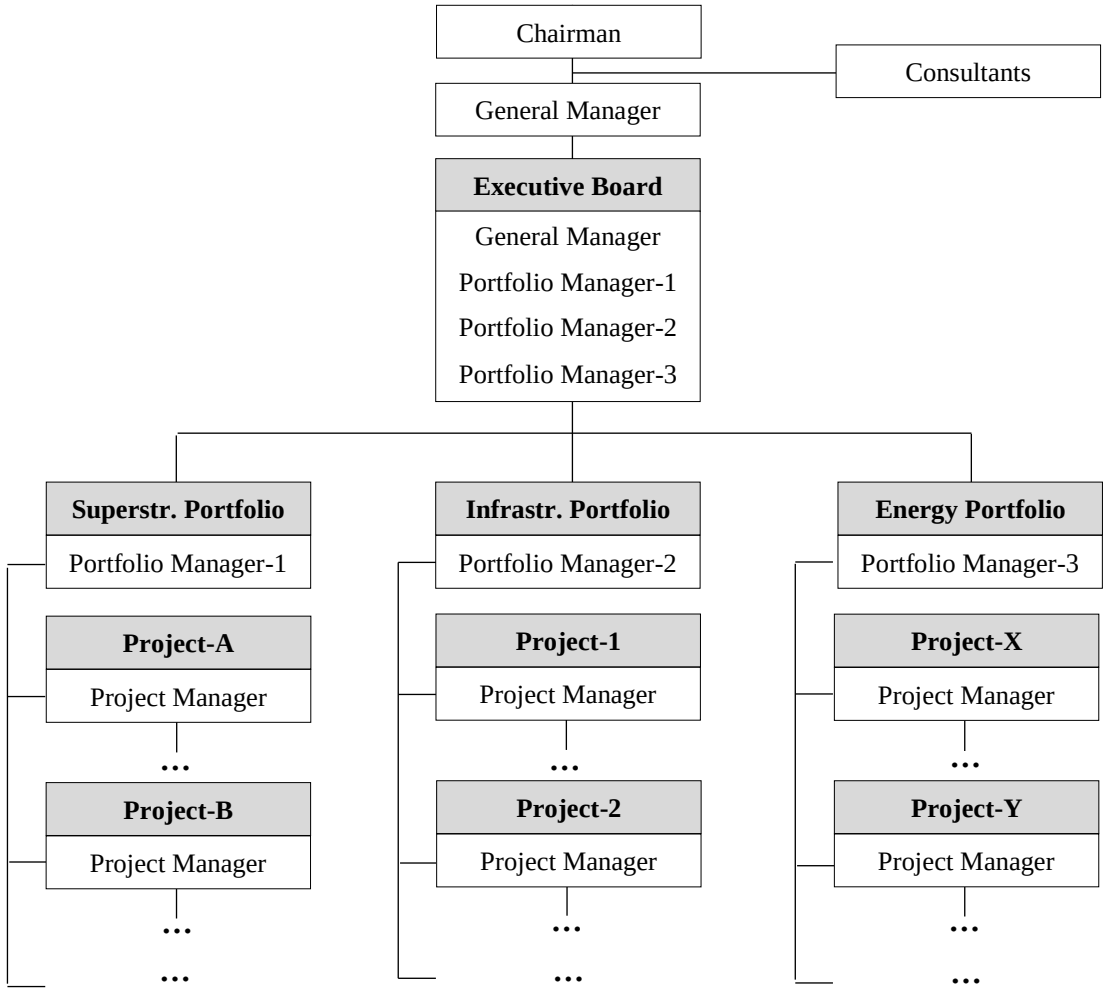

Figure 5.1. Organization Chart of the Company XYZ

Company XYZ has four projects in its infrastructure portfolio. Some information relating to the projects within the portfolio have been presented in Table 5.1.

Table 5.1. *Information about the Projects of Company XYZ's Portfolio*

	Project-1	**Project-2**	**Project-3**	**Project-4**
Client	Government	Government	Government	Private Sector
Location	Turkey	Turkey	Confidential	Turkey
Bid Type	Restricted	Restricted	Restricted	Open
Project Type	Infrastructure	Infrastructure	Infrastructure	Infrastructure
Project Delivery Type	Design-Bid-Build	Design-Bid-Build	Design-Bid-Build	Design-Bid-Build
Contract Type	Turn Key	Turn Key	Turn Key	Unit Price
Contractor Type	Joint Venture	Single Company	Single Company	Single Company
Contract Value	$ 100-500 M	$ 10-100 M	>$ 500 M	$ 10-100 M
Duration	>36 Mo	0-12 Mo	13-24 Mo	0-12 Mo

5.1.2. Aims of PPM Application

Company XYZ predominantly operates in superstructure projects and is specialized in this field. However, the portfolio that has been looked into within the case is a new business segment for the company and includes infrastructure projects in it. In recent years, the company has decided to enter the infrastructure market and to specialize in this area. Some of the reasons behind this decision are;

- Increasing intensity of competition in superstructure projects market,
- Market shrinkage in superstructure projects market,
- Turkish Government's investment program, which is more focused on the infrastructure projects
- Relatively bigger projects in infrastructure market (compared to superstructure projects)

The motivation in embracing portfolio management in infrastructure projects which is a new area of operation for Company XYZ is the desire to achieve company level strategic goals and increasing the chance of succeeding by optimizing resource allocation between projects. Therefore, this portfolio holds importance in mid-term and long-term for the company. Company XYZ has identified its three main goals in implementing portfolio management as follows:

- Firstly, sticking to a predetermined budget, time, scope and quality standard which will enable the company to gain know-how in this new business segment and turning this know-how into corporate memory.
- Secondly, attaining the work completion certificate for participating in bigger bids in the future.
- Lastly, creating a pool of proficient personnel, subcontractors and suppliers to cooperate in this field of expertise.

5.1.3. Methods of PPM Application

The methods that were executed in portfolio management by Company XYZ can be grouped under two categories which are project prioritization and resource allocation. Methodologically, in the PPM process, prioritization is determined among the projects in the portfolio firstly. Then, it leads to taking action for optimal resource allocation between projects according to the order of precedence.

5.1.3.1. Project Prioritization

Priority order of the projects could present severe changes periodically and the executive board reviews the evaluations on the matter at certain intervals. In the process of determining the priority order of the projects within the portfolio, the factors in consideration are as follows:

Strategic Value is one of the most determining elements of the importance of a project in the portfolio. Projects which present concordance with the portfolio's and/or company's strategic perspective are one step ahead of other projects within the portfolio. These projects are becoming high priority projects in order to increase the probability of success. The strategic value state of the four projects in the portfolio which are the subject of the case are as follows:

- Project-1 was the first transportation project of the Company XYZ. Since the company was very eager to get new transportation projects in near future, they made serious amount of investment to road making machinery and equipment. Since it was the first project in that field, Project-1 had an important strategic value.
- Project-2 had a very short duration and its budget is large compared to its duration. It has a strategic value in terms of providing cash to the company in a short time. Furthermore, due to the business volume of the client of this project, keeping the client satisfaction at the highest level will pave the way for potential future jobs.
- Project-3 is the first overseas project of the company after many years. It has a strategic importance because of the business potential and possible future projects in the country (name of the country is kept as confidential).
- Project-4 has been taken later than the other three projects and it has less strategic importance compared to other three projects.

Contracts are another criterion used by Company XYZ to prioritize projects in the portfolio. The client; who is the other party of the contract, could be a determinant in the prioritization process of the projects. The subjects such as type of the client (the public or private sector), power and interest of the client or business volume of the client are considered by Company XYZ in determining the importance of the projects. In addition, important contractual clauses such as budget, duration, technical specifications, quality targets and delay penalty mentioned in the contract also play an

important role in prioritizing projects. Contractual status of the four projects are as follows;

- Project 1 has been tendered by one of the Turkish governmental agencies. Not only this client has been never worked with before, but also the chances of working with this employer on another project in the future is extremely low. Project time and budget are reasonable compared to the scope of the project.
- Project-2 is also employed by another governmental agency of Turkey. There has been no previous work done with the client also. However, working with this client in the future projects is extremely important for the company. Therefore, it is desired to keep the client satisfaction at the highest level. On the other hand, duration of the project is significantly short for the project scope and there are severe delay penalties defined in the contract.
- Project 3, from the financial point of view, was the biggest project that has been undertaken by the company. The project was critical due to the volume and complexity of the work scope.
- Project 4 was tendered by the private sector. The work capacity of this client was less compared to other clients. The project was small, straightforward and easier to construct compared to the other projects in the portfolio.

Project phase, alongside with strategic value and contract, is another important factor affecting project prioritization for Company XYZ. One of the biggest indications of this is even thought Project 4 seeming strategically and contractually less important than other projects, when its due date came closer it could take priority over other projects. Projects seem less critical in the initiation and planning phases as opposed to following phases. However, in the execution and especially in the closing phase the situation could turn completely otherwise.

5.1.3.2. Resource Allocation

After having prioritized its projects, Company XYZ transfers resources in between projects when needed and possible to use resources such as money, human resources, machinery and equipment optimally. By doing so, achievement of global portfolio success and strategic goals are aimed. The resources that are transferred between projects by portfolio managers are as follows;

Indirect personnel, especially technical personnel are frequently transferred between projects. For instance, at the earlier stages of the project, planning engineers take very active duty. When a new project is undertaken, since the recruitment process takes time, some of the planning engineers are moved to that project to prepare the schedules to be handed to the client and to create budget and schedule for the project management purposes. Similarly, when it's time to do the final account; which takes place at the ending periods of the project, engineers might be transferred to that project from other projects.

Direct personnel are another resource that is frequently transferred between projects - especially, operator worker groups alongside with the machinery.

Subcontractors typically work only on the project that they have been signed contract with due to certain legal and contractual limitations. Despite the fact, Company XYZ transfers work force and machinery equipment between the projects to a degree if the subcontractor has been signed contract with multiple projects of the company at the same time periods.

Machinery and equipment are another resource that are transferred often between projects. Especially certain machinery which does specific work on the site and needed in limited period are regularly transferred between the projects when needed.

Knowhow is an important part of Company XYZ's vision and the leading resource the company wants to be transferred between projects. An extensive IT infrastructure has been put into place for information to be systematically stored and accessible across projects. In order for the reports, important metrics, and "lessons-learned" to be shared over the ERP program, Company XYZ not only has made investments in software but also provides educational programs for their personnel.

Financial resources come into prominence as Company XYZ's most transferred resource among its projects. In order to compensate cash deficit of the projects, financial resources are transferred from a pool formed for this purpose.

5.1.4. Results

Company XYZ tries to optimize transferring of resources between projects by bringing PPM practices to life. Thanks to PPM applications, in the initiating and planning phases of Project-2, Project-3, and Project-4 which all started after Project-1, transfer of technical staff was provided from other projects, so that negative effects of delay caused by recruitment processes have minimized. Machinery and equipment which have completed their periodical task or were needed for a length of time were made use of in other projects alongside direct personnel. To prevent the negative effects of cash flow fluctuations, financial resources were also transferred in between. The establishment of IT infrastructure provided know-how transfer between projects.

- Project-1, which seemed to be a lucrative project, in the beginning. However, it has performed very poorly and resulted in financial loss. Company XYZ's inexperience about the transportation projects and the unfavorable impact of problems that occurred with the client during the course of the project caused the failure. Time and budget goals deflected severely, and the project was unsuccessful.

- Project-2; which was a fast track project, with its wide scope and contract value relative to its limited time was very challenging for Company XYZ. Since the duration of the project is very demanding, working with qualified subcontractors and suppliers was essential. The vision of the company about IT systems and "lessons-learned" database played a big role in choosing the right subcontractors and suppliers for this project. Furthermore, a significant amount of machinery-equipment and direct personnel were periodically transferred to this project. In return, the fast liquidity creation potential of this project has provided serious funding sources for other projects of the company. This project was completed within time and budget goals and became successful.
- Project-3 was the biggest project Company XYZ has undertaken in its history so far, being the first overseas project after many years as well. Because of the difficulties that come with mobilizing in another country, technical staff from other projects have provided vital contributions to the initiating and planning phases of the project. This project has been suspended without the construction could even begin due to employer's financial troubles and therefore is not included in the success evaluation of the portfolio.
- Project-4 was the second transportation project that Company XYZ has undertaken following Project-1. A significant amount of working personnel, machinery and equipment from Project-1 have been transferred to this project. Furthermore, the experience attained from Project-1 has prevented the reoccurrence of the problems of Project-1. As of the time the interview was conducted, the project has been ongoing within its time and budget goals and is considered to be successful.

Out of four projects within portfolio scope, one was unsuccessful, two were successful and one did not qualify for evaluation. When the overall portfolio itself is evaluated, both the company's top management and Mr. Smith found the portfolio successful. The reason for this consideration has to do with the fact that although the first project

in a field which the company has recently entered failed, the experience gained from that successfully aided the subsequent projects in effective use of resources and thus making the company more successful.

5.1.5. Discussion

Company XYZ is considered not only an early adopter of PPM in Turkey, but also a successful example as an implementer of the method. PPM is still a relatively new concept to the construction industry both in Turkey and the world. Successful implementation of PPM relies on many factors related with project management and portfolio management; which make it directly correlated to corporate identity and culture of the firm. But most importantly, PPM success is strongly linked to strategic goals of the contractor making it essential for a contractor to have a mission in the goals it intends to achieve.

Company XYZ has decided to implement PPM due to their increase in work volume and project scope variety. Top management of Company XYZ has stood their ground on the subject which enabled the firm to restructure accordingly and portfolio managers to do the task in a more effective manner. Portfolio managers have closely followed up the state of the projects they were responsible for and strived to take actions suited to contractor's strategic goals and portfolio's success by transferring human resources, machinery and equipment as well as financial and information resources temporarily or permanently thus focusing on portfolio success instead of singular project success.

5.1.6. Recommendations

In conclusion to the PPM practices they applied at Company XYZ and the results they yielded, Mr. Smith has stated the importance of enabling resource transfer in between projects in a manner that focuses on company's and portfolio's success instead of the

success of singular projects. He added the biggest problem they have encountered in PPM practices was the reluctant attitude of projects managers when the need for transferring a resource from their projects to another project in the portfolio occurred. He observed project managers have occasionally gone as far to resort to some methods in order to prevent the transfer resources from their project to another, because they were focused on the success of their own projects and by extension their success, even at times the said resources were not immediately needed by them. Mr. Smith pointed out in order to prevent such occurrences and implement PPM effectively, top management of companies needed to take a firm stance on the subject and establish clear boundaries of authorization and accountability in resource transfers. In addition, if a reward and punishment system were to put in place on the company level, it would be more beneficial if the reward was given related to portfolio success instead of singular projects success and punishment should be determined based on singular project performance.

5.2. Second Case Study

5.2.1. Introduction

The subject of the second case study, (Company ABC), is a construction company which has been constructing superstructure projects in nearing 15 years of experience. The company has awarded a superstructure project of a municipality of a relatively underdeveloped city of Turkey and have decided to apply PPM after picking up another project that is a close location to the first one and by the same client. Synopsis of these two projects is presented in Table 5.2.

The professional with whom the in-depth interview was conducted, Mr. Black, is a civil engineer with 20 years of industry experience and has worked as a project manager for one of the projects in the portfolio the case study focuses on.

Table 5.2. *Information about the Projects of Company ABC's Portfolio*

	Project-1	**Project-2**
Client	Government	Government
Location	Turkey	Turkey
Bid Type	Restricted	Open
Project Type	Superstructure	Superstructure
Project Delivery Type	Design-Bid-Build	Design-Bid-Build
Contract Type	Turn Key	Turn Key
Contractor Type	Single Company	Single Company
Contract Value	$ 100-500 M	$ 10-100 M
Duration	13-24 Mos	13-24 Mos

5.2.2. Aims of PPM Application

The first project which was acquired in the scope of the portfolio was lucrative as well as having a hefty contract price. The second project which was being tendered in the same city was an open bid and therefore the competition was higher for it. Since Company ABC has already established a building site and was mobilized in the area, had an advantage over its competitors. In this competitive environment, Company ABC was able to offer a very low offer for Project-2 and won the bid. Even though the project did not appear to be lucrative, the company had a strategic goal; augmenting company turnover.

5.2.3. Methods of PPM Application

The upper management of Company ABC was aiming a turnover increase as a strategic goal. For this purpose, right after acquiring a big and lucrative project, they have also picked up on a smaller project which was being tendered in the same city by bidding very low. Company ABC has taken a significant risk by low-bidding. The basic method applied by Company ABC in order to carry this portfolio of two projects

with mostly intersecting timelines and locations to create a joint resource pool and using the same resources in both projects as much as possible to reduce the cost.

The joint resource pool application was first to be used in the retrenchment of indirect personnel. At the same time, since the two sites were very close to each other, a good organization of using the machinery at the maximum productivity level was sought. In addition, with the growing work scope after winning the second projects, it was thought economies of scale could be applied.

Both of the projects had a project manager in addition to having a portfolio manager appointed to the portfolio itself. Resource transfer between projects was under the control of the portfolio manager. A joint project management office was put in place for the management of both projects and the PMO had two engineers on deck. Both of the engineers tended to both projects. One of the engineers was responsible for scheduling and planning and the other one was working in budget and cost control. The PMO was reporting based on the data they were producing as well as the data attained from technical offices of these two projects. All the reports were being given to the project managers and the portfolio manager who were trying to optimize the resources in the light of these reports.

5.2.4. Results

Applying PPM to two projects in the same city with close locations with mostly intersecting construction timelines have provided a serious advantage to Company ABC in terms of indirect personnel. For example, the number of engineers, if these projects were independent and in different cities, was going to be 30% more in comparison. Another advantage the PPM application has provided to Company ABC is the economies of scale. With the addition of the second project, Company ABC has reached a working volume that was able to arouse the interest of more subcontractors and suppliers. In addition to that, with economies of scale, unit costs have decreased.

Since both of the projects were superstructure projects and involved similar productions, subcontractors and suppliers tendered for both of the projects generally. The principals of economies of scale were in effect and unit costs were decreased. Tender of Project-1 was won with a significant profit foresight. In addition, its contract value was six times more than Project-2's contract value. Bid of Project-2 was significantly low and did not appear to be lucrative. Consequently, Project-1 was completed in the foreseen timeline with a profit rate that was close to the estimate. Project-2, on the other hand, was completed with a time overrun of 20% and a budget overrun of 30%. Project-2 concluded at a loss due to delay and increased costs. However, thanks to Project-1's contract value being much greater to Project-2's, the profit obtained from Project-1 has easily covered the loss of Project-2. Even though one of the projects in the portfolio was successful and the other one failed, since the portfolio resulted in profit overall and served the purpose of increasing the turnover which was a strategic goal for the company, the portfolio was perceived as a success by the executive board of the company.

5.2.5. Discussion

Company ABC has acquired Project-1, a high-cost project, with a high-profit expectation. The company had difficulty meeting the minimum turnover criteria for bids and had the strategic goal of increasing their turnover. Soon after winning Project-1; Project-2, which was being tendered by the same client and had a close location to Project-1 was acquired through very competitive bidding. Company ABC has significantly lowered their bid in order to acquire Project-2. What drove Company ABC to this action was their belief that they could decrease the costs by managing both of the projects in the portfolio from a joint resource pool.

Joint resource pool approach has granted advantage to Company ABC in reducing costs. In comparison to using a different set of machinery-equipment and personnel independently for both projects, using the joint pool have helped the cost savings. In

addition, both projects having similar scopes and close locations have created higher work volume for subcontractors and procurers. The economies of scale helped them to reduce the cost of unit prices and subsequently created the cost savings as well.

As a result of PPM application, Project-1 was able to be completed in the predicted timeline and budget, however, that was not the case for Project-2. Project-1's contract value, being 6 times greater than Project-2, have easily compensated the loss Project-2. At the same time, the PPM application has helped to reduce the severity of loss results from Project-2.

Even though one of the two projects in the portfolio was unsuccessful and resulted in a loss, the portfolio was perceived as successful by the company since the portfolio profited in the end and the failed project served the strategic purpose of increasing turnover.

5.2.6. Recommendations

Mr. Black has stated he has previously been involved in other PPM application attempts in other companies. Mr. Black proceeded in his statement by adding his PPM experience in Company ABC has been more successful in comparison to his other experiences. The reasons for this were: Firstly, the portfolio contained very few projects, secondly, the projects in the portfolio were in close locations, thirdly, the company had experience in the field of expertise and lastly, projects were very much alike.

Mr. Black recommends keeping the size of the portfolio smaller or at a manageable scale and choosing projects that are close to one another if possible, for PPM success. He adds, choosing similar projects and projects in accordance with company's experience will reduce portfolio risk and therefore increase the possibility of success.

5.3. Third Case Study

5.3.1. Introduction

The subject of the third case study, 123 Group, is a Turkish group of companies who have been active for 25 years in many countries around the world and in different industry fields. The main branch of the operation is producing construction materials and the company supplies prefabricated buildings and steel structures to the construction industry. The group has further investments in the food industry.

Mr. Johnson, the professional with whom the in-depth interview was conducted with is a civil engineer who has been working in 123 Group over 20 years. He has held positions ranging from field engineer to project manager. Currently, he held the title of Deputy General Manager who's responsible for the technical works at 123 Group headquarters.

Table 5.3. *Information about the Projects of 123 Group's Portfolio*

	Project-1	**Project-2**	**Project-3**	**Project-4**
Client	Private Sector	Private Sector	Private Sector	Private Sector
Location	North Africa	North Africa	Russia	Azerbaijan
Bid Type	Negotiated	Negotiated	Negotiated	Negotiated
Project Type	Superstr.	Superstr.	Superstr.	Superstr.
Project Delivery Type	Design-Build	Design-Build	Design-Build	Design-Build
Contract Type	Turn Key	Turn Key	Turn Key	Turn Key
Contractor Type	Single Company	Single Company	Single Company	Single Company
Contract Value	$ 100-500 M	$ 100-500 M	$ 100-500 M	$ 100-500 M
Duration	0-12 Mos	0-12 Mos	0-12 Mos	0-12 Mos

The construction projects 123 Group conducts are located in North Africa, Russia and Azerbaijan. All of the projects are prefabricated building and steel construction projects tendered by the private sector. Prefabricated construction allows a much greater speed in comparison to conventional on-site construction. Therefore, the projects 123 Group has are quite swift (0-12 months) and large in the financial scale ($ 100-500M). The summary information on 123 Group's projects in their portfolio are presented in Table 5.3.

5.3.2. Aims of PPM Application

The corporate strategy of 123 Group is turning their operation into a holding. The company has been providing services under many different firms and in many countries, including construction supplies, prefabricated building, steel structures, and food industry. By turning their operation into a holding status, they aimed to:

- Establish a more corporate structure
- Increase their brand awareness for commercial purposes
- Create a consolidated financial structure for their scattered group companies.

123 Group wanted to unite the firms founded with the purpose of doing business in the construction industry in multiple countries and add PPM practices as the project management methodology. In doing so, the company aimed to;

- Establish a central purchasing department to increase their bargaining opportunities and following expenses more closely,
- Transfer the experience gained in different countries into projects that take place in other countries,
- Be able to finish off the project within the timeline and budget goals,
- Gather new projects to be contracted under a single company and by doing so increasing the turnover and completion certificate level of the company,

- To be able to enter the ENR Top 250 International Contractors in five years.

5.3.3. Methods of PPM Application

123 Groups has started applying PPM in order to better manage their projects which were scattered through different parts of the world. 123 Group's PPM practice was limited as their projects were in different countries. Because of the long distance between projects, transfer of the physical resources was not feasible. At the same time, the construction projects were gathered under one company and that company was included in the holding, creating a central financial structure. In addition, purchases of the projects were not being conducted on site but through a central purchasing department.

When shot from the human resources angle, the work was being done by personnel on site. The central office's duty was project management and supervision. The senior personnel who worked in central offices shared the experience they gained in previous projects with the personnel who worked on site. The aim in that was to increase the chances of projects succeeding by transferring know-how and experience between projects.

Meetings were held once a month by teleconference method with the project managers. These meetings were done with the presences of project crew on site, top management, portfolio manager and heads of central departments. Project crew did presentations about their respective projects in the meetings. The contents of the presentation included the project's status and progress, financial and physical reports, risks, opportunities as well as the hardships encountered and solution suggestions. After every monthly meeting for each project, central management held exercises in taking action for the projects and for overall portfolio.

5.3.4. Results

As a result of the PPM applications, 123 Group has finished two of the four projects in their portfolio on time and on budget. The other two projects did not achieve time and budget targets. When looked from the strategic perspective of the group, they seem to have adopted a more central way of management. In parallel of the group's process in transforming into a holding, their construction industry endeavors have started being handled by a singular central structure.

With the introduction of a centralized finance and purchasing approach, the purchase expenses were somewhat reduced and were able to be followed more closely. Even though money transfers between the projects provided a periodical contribution to the projects, a delay the payments to the subcontractors and procurers occurred across the portfolio. The work within the scope of subcontractors and procurers whose payments were delayed, delayed work in return, therefore affecting the performance of the projects.

Some of the goals regarding the portfolio and the company were accomplished. However, being-on-time, which is essential in 123 Group's field of the industry has not been accomplished for two of the projects. Therefore, the portfolio was regarded as unsuccessful by the top management and the portfolio manager.

5.3.5. Discussion

As a result of the centric structure and PPM application performed by 123 Group, an increase in bureaucracy has been occurred in the internal operations of the company. For instance, a payment that had to be approved in the central office gained a significant increase in the route that had to be followed, creating delays in payments in many projects. At the same time, spontaneous needs of the projects such as

personnel recruitment and renting machinery-equipment had been provided from the central office and this method reduced the agility of the projects.

123 Group provides services in prefabricated buildings and steel structures. The nature of this field of expertise is to complete the projects as soon as possible. Delays occurred in two of the projects in the portfolio have created a very bad image for the company and went on being a negative reference for the potential projects the company might want to undertake in the future.

5.3.6. Recommendations

Mr. Johnson has stated PPM applications can be quite useful for the construction industry. However, he also added that a PPM application done without consideration for sector and company dynamics could do more harm than good.

Mr. Johnson links the unsuccessful PPM application that took place in 123 Group to industrial dynamic. He explained that prefabricated constructions are preferred specifically because of its speed and for that reason contractors who honor the time commitments are preferred by the clients. He went on to say that PPM and a centralist view of project management reduce the agility of the project and therefore caused failure in their example. He emphasized the importance of dynamics of the industry, company and the countries the projects took place into consideration is needed for a PPM project to be successful.

In conclusion, three cases about PPM application were conducted in the scope of this study. Companies decided to implement PPM due to the reasons such as increasing work volume, project scope variety, market shrinkage, increasing intensity of competition and economies of scale. In two of the cases companies successfully implemented PPM and benefit from it, and in one case portfolio regarded as unsuccessful by the top management and portfolio manager of the company. However,

even in the unsuccessful portfolio’s case, company took some advantage of PPM application such as increase in bargaining power and cost savings resulted from economies of scale.

CHAPTER 6

CONCLUSIONS

6.1. Conclusion

PPM in construction sector is very rarely studied in the literature and understanding the mechanics of the success factors behind the portfolio is one of the most complex parts of the equation. Over the years, factors such as more complex construction projects, growth of companies, undertaking more than one project at once and increased competition have led to a search of new methods in project management. Nonetheless, holistic approach and resource optimization capabilities of PPM provide a competitive advantage to construction companies.

In the scope of the study, three in-depth interviews were made with expert construction professionals with 20-30 years of business experience and three case studies were constructed regarding with application of PPM in their companies. These cases contain a wide variety of PPM applications; domestic and global projects, big and small sized companies, from small to mega projects, successful and unsuccessful applications. In addition to that, project and portfolio data were collected through a survey which was conducted with 22 professionals from the construction sector and they evaluated one of their past portfolios according to the 36 success factors presented. In total, data of 22 portfolios and 73 projects were collected and analyzed in this study.

This study helps to comprehend construction professionals' perception about PPM; such as how they define success of PPM, prioritize projects in the portfolio and their approach to resource transfer between projects.

In addition, the study reveals the prominent factors in portfolio success in construction sector. A logistic regression model was constructed to predict the success probability of a given portfolio, and five-fold cross validation applied to measure predictive power of the model. Moreover, a sensitivity analysis was performed to show how success probability reacts to changes in performance of success factors.

It is worthy to note that, PPM in construction sector could be regarded as a newly arising subject for the literature and studies related with this subject are very scarce. At that point, this study will help to develop literature with its findings regarding benefits and barriers of PPM applications, determinant success factors, real world case studies and perception of industry professionals related with PPM and its applications.

When we analyze two hypotheses stated in the Introduction part, we see that, first hypothesis; which is "most important factors of portfolio success are related to factors related with the projects", could be rejected because portfolio related factors shine out in the success of portfolios, which are followed by human resources related factors. In addition, hypothesis of "the resource transfer between projects, which is done to optimize the allocation of said resources positively correlates with portfolio success" is validated as the financial and machinery/equipment transfer found as significant success factors of portfolio and positively correlates with it.

Besides the academic perspective, companies and sector professionals could benefit from this study from the business aspect. Covered case studies provide strong insights regarding successful and unsuccessful PPM applications. Provided regression model could be used by construction companies to raise a mathematical approach in terms of success probability of their portfolios. One step further, bigger companies with multi portfolios could evaluate their portfolios' performances and chances of success with this regression model.

6.2. Limitations

Every research method has its advantages and disadvantages in their nature. While it was great for the purposes of this study, the survey method has the disadvantage of participants not complying in ideal means. What we mean by that is that participants might have faulty memory, may not pay enough attention, or be reluctant to give the answers that will not represent them in the best light.

Throughout the study, it was stressed over and over again that project portfolio management, PPM, was a relatively new concept for the construction industry. This was always going to be a limitation of the study. Since PPM is not a widely applied practice in the construction industry, the data gathering process was affected as it was limited to a data pool of a certain size. A second limitation of PPM being a new concept transferred from the finance sector is that there are not clear guidelines or methods to its application and therefore the common qualities of successful portfolios are hard to shed light on. This limitation was managed by adding case studies to the thesis as an attempt of showing the train of thought that goes into the managerial aspect of PPM practices.

Another limitation has to do with the construction industry itself, the perception of success to be specific. The literature review showed that what is considered successful in the construction industry is an extremely subjective matter. Expectations of the parties who put together a construction project are very different thus their perceptions are different. When investigating PPM, data sample mostly consisted of civil engineers who through their decades of experience are now in managerial positions. The way they view the success of their projects and portfolios by extension are bound to be from a technical and managerial perspective. This limitation was managed by focusing on portfolio success itself, as PPM success mostly has to do with the fact that it serves the strategic goals of the company.

Lastly, it should be mentioned that while the study did its absolute best at producing patterns that lead to PPM success by asking the participants to give information like size, contract type, duration, budget, etc., it seems that PPM success is correlated to the perception of upper management and executive boards who apply PPM for strategic goals. Therefore, although it is a valid point to say a portfolio was successful for serving the strategic goal it was applied for, the actual success of the PPM "process" could not be analyzed as much as the study would have liked to.

6.3. Directions for Future Research

The future of PPM in the construction industry could be a very exciting and useful topic of research, as it is for new concepts in their respective fields, as it is full of possibilities.

An obvious topic for future research could be the collaboration between academics of finance and civil engineering. Since PPM originated from finance and banking sectors, the difference between PPM applications of the finance and construction industries could be a very useful topic of research as it would not only be helpful in understanding whether the process differentiates between industries, but also whether failed PPM attempts in the construction industry could be improved by applying methods used in the finance sector.

Since the perception of success itself is a subjective topic in the construction industry, a study consisting of several case studies involving in-depth interviews with all stakeholders of the projects in a portfolio could be done in order to investigate the differences in perception of success in PPM practices.

Studies focusing solely on a single criterion of performance indicators would be helpful in further investigating the patterns of successful PPM applications. Doing so would eliminate the surrounding factors and lead to better understanding if portfolios

of certain sizes, types, contract types, values, and durations affect PPM success and if so, what is the optimal value of these factors in successful portfolios.

Similarly, whether different types of construction projects (infrastructure, superstructure, energy, etc.) respond better to form a portfolio could be investigated. The existing research in literature stresses the importance of “project selection” in PPM applications. While in theory, it stands to reason that projects of similar types are better off paired in portfolios, two questions remain relatively unanswered. Firstly, whether sub areas of construction industry respond better to PPM and secondly, projects that could otherwise come together due to location or other variables could be put together in order to achieve other strategic goals a company might have. In addition to these, different analysis method for predicting portfolio success such as machine learning could be used as future research topics.

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APPENDICES

A. Survey Questions

AÇIKLAMA

Portföy Yönetimi:

Birden fazla inşaat projesinin bağımsız olarak yönetilmesi yerine, belirli stratejik hedefler doğrultusunda birlikte yönetilmesidir.

Bu şekilde projelerde kaynak kullanımının daha etkin hale getirilmesi ve tekil olarak proje başarısı yerine, toplam portföy başarısının arttırılması hedeflenmektedir.

Anket Açıklaması:

Anket boyunca, profesyonel yaşantınızda bir parçası olduğunuz herhangi bir inşaat portföyünü, size verilen kriterlere göre değerlendirmeniz beklenmektedir. Anket kişisel bilgiler (7 soru) ve portföy yönetimi (41 soru) ile ilgili toplam 48 soru içermektedir.

Anket, değerlendireceğiniz portföyün içerdiği proje sayısına göre 15-30 dk arasında değişkenlik gösterebilir.

PART-A | KİŞİSEL BİLGİLER

01/48 **Mesleğiniz**

- ☐ İnşaat Mühendisi
- ☐ Mimar
- ☐ Diğer _____

02/48 **Eğitim Durumunuz**

- ☐ Lisans
- ☐ Yüksek Lisans
- ☐ Doktora

03/48 **Mesleki Tecrübeniz**

- ☐ 0-5 Yıl
- ☐ 5-10 Yıl
- ☐ 10-15 Yıl
- ☐ 15-20 Yıl
- ☐ 20-25 Yıl
- ☐ 25 Yıl Üzeri

04/48 **Meslek Hayatınızda Görev Aldığınız Proje Tipleri (Birden fazla seçenek işaretleyebilirsiniz)**

- ☐ Üst Yapı
- ☐ Alt Yapı
- ☐ Enerji
- ☐ Endüstriyel Tesis
- ☐ Diğer _____

05/48 **Meslek Hayatınız Boyunca Görev Aldığınız Projelerin Lokasyonları**

- ☐ Sadece Bir Ülkede Görev Yaptım.
- ☐ Birden Fazla Ülkede Görev Yaptım.

06/48 **Daha Önce Bir İnşaat Projesinde "Proje Müdürü" veya Dengi Pozisyonda Görev Aldınız Mı?**

- ☐ Evet
- ☐ Hayır

07/48 **Daha Önce İnşaat Projelerinde "Portföy Yöneticisi" veya Dengi Pozisyonda Görev Aldınız Mı?**

- ☐ Evet
- ☐ Hayır

PART-B | 1- PROJE İLE İLGİLİ FAKTÖRLER

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
08/48 **İşveren Tipi**										
Devlet	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Özel Sektör	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Firmanın Kendi Yatırımı	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Diğer	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
09/48 **İhale Tipi**										
Açık İhale	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Belli İstekliler Arasında (Davetiyeli)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Pazarlık Usülü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Diğer	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
10/48 **İşin Tipi**										
Üst Yapı	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Alt Yapı	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Enerji	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Endüstriyel Tesis	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Diğer	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
11/48 **Sözleşme Kapsamı**										
Sadece Yapım	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tasarım + Yapım	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Diğer	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
12/48 **Sözleşme Tipi**										
Anahtar Teslim	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Birim Fiyat	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Maliyet + Kâr	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Karma	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Diğer	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
13/48 **Yüklenici Tipi**										
Tek Firma	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
İş Ortaklığı (Joint Venture)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Konsorsiyum	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Diğer	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

14/48 **Projelerin Yer Aldığı Ülkeler**	
Proje-1	
Proje-2	
Proje-3	
Proje-4	
Proje-5	
Proje-6	
Proje-7	
Proje-8	
Proje-9	
Proje-10	

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
15/48 **Sözleşme Bedeli**										
0 - 1 Milyon $	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
1 - 10 Milyon $	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
10 - 100 Milyon $	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
100 - 500 Milyon $	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
500 Milyon $ Üzeri	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
16/48 **Sözleşmeye Göre İşin Süresi**										
0 - 12 Ay	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
13 - 24 Ay	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
24 - 36 Ay	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
> 36 Ay	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
17/48 **Gerçekleşen İş Artış Oranı**										
%0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
%1 - %10	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
%11 - %20	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
>%20	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
18/48 **Projelerin Finansmanında Sorun Yaşandı mı?**										
1- Çok Fazla Sorun Yaşandı	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Hiç Sorun Yaşanmadı	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
19/48 **Projelerin Tasarımında (Eksik Detay Çözümleri, Çelişen/Çakışan Tasarımlar, Proje Değişikliği, Kamulaştırma vb) Sorun Yaşandı mı?**										
1- Çok Fazla Sorun Yaşandı	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Hiç Sorun Yaşanmadı	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
20/48 **Sözleşme Yönetiminde (Eksik Sözleşme Ekleri, Uygulanmayan Maddeler, Dengesiz Risk Paylaşımı vb.) Sorun Yaşandı mı?**										
1- Çok Fazla Sorun Yaşandı	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Hiç Sorun Yaşanmadı	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
21/48 **Projelerin Bütçesel Hedeflerinin Gerçekçiliği**										
1-Gerçekçilikten Çok Uzak	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Makul Seviyede Gerçekçi)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
22/48 **Projelerin Süresel Hedeflerinin Gerçekçiliği**										
1-Gerçekçilikten Çok Uzak	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Makul Seviyede Gerçekçi)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
23/48 **Projelerin Kapsam/Kalite Hedeflerinin Gerçekçiliği**										
1-Gerçekçilikten Çok Uzak	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Makul Seviyede Gerçekçi)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

24/48 **Projelerin Firma Açısından Stratejik Bir Önemi Var İse Açıklayınız**	
Proje-1	_____
Proje-2	_____
Proje-3	_____
Proje-4	_____
Proje-5	_____
Proje-6	_____
Proje-7	_____
Proje-8	_____
Proje-9	_____
Proje-10	_____

PART-B | 2- FİRMA İLE İLGİLİ FAKTÖRLER

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
25/48 **Firmanın Proje Konusu İşlerdeki Geçmiş İş Deneyimi**										
1- Çok Az	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2- Az	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3- Orta	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4- Fazla	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Çok Fazla	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
26/48 **Firmanın Finansal Durumu**										
1- Çok Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2- Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3- Orta	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4- İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Çok İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
27/48 **Firmanın Yönetsel Süreçlerinin Etkinliği**										
1- Çok Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2- Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3- Orta	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4- İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Çok İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

PART-B | 3- İNSAN KAYNAKLARI İLE İLGİLİ FAKTÖRLER

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
28/48 **Projelerde Yer Alan Mühendislerin Teknik Yetkinlikleri:**										
1- Çok Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2- Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3- Orta	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4- İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Çok İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
29/48 **Projelerde Yer Alan Mühendislerin Yönetsel Yetkinlikleri:**										
1- Çok Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2- Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3- Orta	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4- İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Çok İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
30/48 **Proje Müdürlerinin Teknik Yetkinlikleri:**										
1- Çok Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2- Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3- Orta	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4- İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Çok İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
31/48 **Proje Müdürlerinin Yönetsel Yetkinlikleri:**										
1- Çok Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2- Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3- Orta	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4- İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Çok İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Porttföy
32/48 **Portföy Yöneticisinin Teknik Yetkinlikleri:**	
1- Çok Kötü	☐
2- Kötü	☐
3- Orta	☐
4- İyi	☐
5- Çok İyi	☐

	Porttföy
33/48 **Portföy Yöneticisinin Yönetsel Yetkinlikleri:**	
1- Çok Kötü	☐
2- Kötü	☐
3- Orta	☐
4- İyi	☐
5- Çok İyi	☐

PART-B | 4- DIŞ FAKTÖRLER

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
34/48 **Projelerin Yer Aldığı Lokasyonların Proje Kapsamı İşler İçin Uygunluğu**										
1- Çok Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2- Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3- Orta	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4- İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Çok İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
35/48 **Projelerin Yer Aldığı Ülkelerdeki Genel Ekonomik Durum Nasıldı?**										
1- Çok Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2- Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3- Orta	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4- İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Çok İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
36/48 **Projelerin Yer Aldığı Ülkelerdeki Genel Siyasi Atmosfer Nasıldı?**										
1- Çok Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2- Kötü	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3- Orta	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4- İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Çok İyi	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
37/48 **Mücbir Sebeplerin (Doğal Afet, Yangın, Terör Gibi) Projelere Olumsuz Etkisi Ne Ölçüde Olmuştur?**										
1- Çok Fazla	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
2- Fazla	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3- Orta	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
4- Az	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5- Etkisi Olmamıştır	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

PART-B | 5- PORTFÖY İLE İLGİLİ FAKTÖRLER

	Porttföy
38/48 **Projeler Arası Parasal Kaynak Transferinin Etkinliği**	
1- Beklentilerin Oldukça Altında	☐
2- Beklentilerin Biraz Altında	☐
3- Beklentileri Karşılayacak Düzeyde	☐
4- Beklentilerin Biraz Üstünde	☐
5- Beklentilerin Oldukça Üstünde	☐

	Porttföy
39/48 **Projeler Arası İnsan Kaynağı Transferinin Etkinliği**	
1- Beklentilerin Oldukça Altında	☐
2- Beklentilerin Biraz Altında	☐
3- Beklentileri Karşılayacak Düzeyde	☐
4- Beklentilerin Biraz Üstünde	☐
5- Beklentilerin Oldukça Üstünde	☐

	Porttföy
40/48 **Projeler Arası Makine-Ekipman Transferinin Etkinliği**	
1- Beklentilerin Oldukça Altında	☐
2- Beklentilerin Biraz Altında	☐
3- Beklentileri Karşılayacak Düzeyde	☐
4- Beklentilerin Biraz Üstünde	☐
5- Beklentilerin Oldukça Üstünde	☐

	Porttföy
41/48 **Portföyün Firma İçin Stratejik Önemi**	
1- Beklentilerin Oldukça Altında	☐
2- Beklentilerin Biraz Altında	☐
3- Beklentileri Karşılayacak Düzeyde	☐
4- Beklentilerin Biraz Üstünde	☐
5- Beklentilerin Oldukça Üstünde	☐

PART-B | 6- BAŞARI DURUMU

	Proje-1	Proje-2	Proje-3	Proje-4	Proje-5	Proje-6	Proje-7	Proje-8	Proje-9	Proje-10
42/48 **Projelerin Başarı Durumu**										
Başarılı	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Başarısız	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	Porttföy
43/48 **Portföyün Başarı Durumu**	
Başarılı	☐
Başarısız	☐

PART-B | 7- GENEL DEĞERLENDİRME

44/48 **Portföy Başarısını Nasıl Tanımlarsınız?**

45/48 **Portföy İçindeki Projeleri Önceliklendirirken İlk Olarak Hangi Faktörleri Göz Önünde Bulundurursunuz?**

46/48 **Ne Tür Portföylerin Başarı İhtimalini Daha Yüksek Buluyorsunuz?**

47/48 **Portföy İçindeki Bir Projenin Başarı Şansını Arttırmak İçin Diğer Projelerden Taviz Vererek Kaynak Aktarımı Yapılmasını Uygun Bulur Musunuz?**

48/48 **Portföy Başarısını Arttırmak İçin Uygulacak En Etkili Yöntemler Sizce Nelerdir?**