Critical Factors Contribute to Construction Project Success: Study of Success Factors in Relation to the Project Size.

Master thesis

International Master of Science in Construction and Real Estate Management

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Dedication

This work is dedicated to:

To the woman whose heart is beating with love and kindness:

My mother

To whom I keep respect and appreciation for his guidance:

My father

To with whom I shared unforgettable laughs and memories:

Wesam, Ola, Saba, Aous

To my sweetheart who lighted up my life, my "petite lune":

Mathilde

To those people who I deeply miss, and not able to see:

My family and friends in Syria

To you all I dedicate my work……

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Finally, I would like to thank every professional dedicated a time to share his/her experience and knowledge with me, or participate in the survey conducted in this research, which allowed me to reach my goals….

Metropolia

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Conceptual Formulation
Master Thesis for Mr. Waseem Alshami
Student number 0557596

Topic: Critical Factors Contribute to Construction Project Success: Study of Success Factors in Relation to the Project Size.

Background

Construction industry is a competitive, complex and high-risk business. It also represents a considerable proportion of the national economy for most countries. Therefore, failure of construction projects, which is increasingly reported in the business, has a negative impact on the business and countries' economies. Hence, studying the critical factors in achieving project success is crucial and essential to improve the construction industry.

Critical success factors can vary depending on the size and nature of the project and companies involved in the project. However, it is still possible to group these factors and investigate the most common ones.

Nevertheless, there are many success factors and it might be possible to connect these factors with the project size and built-up area which would lead to results that might differ from what is already exciting in literature since the later includes researches that studied factors that affect projects in general.

In light of the above-mentioned points and ideas, the proposed thesis will research the critical success factors in construction projects and it will focus in

the relation between these success factors and the size of the construction project. Therefore, the proposed thesis's goals and questions are:

1- The state-of-art in literature regarding construction project success.
2- What are the most important success factors?
3- Are success factors for construction projects interrelated?
4- How the success factors are changing between different project sizes?
5- Is there a relation between critical success factors and the size of the construction project?

Method:

The research will be conducted through gathering information and data from reliable resources. Internet-based research shall be conducted to collect conferences' papers, white papers, e-books …etc. Resources that include case studies would be the core of the gathered information. These case studies from different resources would be gathered compared and analyzed.

Moreover, semi-structured interviews with project managers and professionals will be conducted. The interviews shall be focusing on a certain type of projects to find out the relation between the project type and success factors. In addition, a questionnaire shall be prepared and tested. This questionnaire shall be sent to construction companies aiming the key persons in projects. The data will be extracted and examined from the questionnaire. The information from the interviews and the questionnaire will be compared with the information in the literature.

Resources

All required resources will be available since it is mainly based on internet research. Moreover, questionnaire will depend on e-mails, hence, the costs of doing the questionnaire is not major. The research will be carried out in Berlin which reduce the costs of traveling if required.

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Signature of the Supervisor

Abstract

Construction industry constitutes a considerable proportion of the national economies of many countries. Therefore, success in this competitive, complex and high-risk business is of a special importance. This success has been thoroughly researched attempting to avoid failures in construction projects that are increasingly reported. Nevertheless, the majority of the previous studies focused on success in general without considering the project's attributes but just mentioning them as possible influencers over the success factors. Therefore, this research conducts a positivistic, cross-sectional, and deductive study approach, attempting to identify the most important success factors in construction projects and their interrelation and correlation with the size of the project.

This thesis consists of four main chapters after the introduction chapter. In the first chapter, a thorough literature review is conducted to provide a clear picture of the current situation of the construction industry in general and construction project management in specific, and to identify how projects are categorized. In addition, this chapter introduces success criteria and success factors from previous works. The research methodology is discussed in the third chapter, which justifies the research philosophy and explains the total framework of the thesis. Moreover, building the semi-structured interviews and the survey, which are the main tools used in this research to collect the primary data, is also explained thoroughly in this chapter along with the pilot study. Analyzing primary data that was collected using the abovementioned tools is conducted in the fourth chapter. Moreover, determining success factors and the correlation between them and with the projects' sizes are the main part of this chapter.

Finally, the fifth chapter will provide the conclusion of this research and the recommendations that might be important for future studies that will be conducted in this field. The results of this research emphasize the importance of certain success factors and also show that success factors could be divided into two groups, the level of importance of first group's factors is not related to the sizes of the project, while in the second group the level of importance for each factor varies from one project size to another.

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List of Abbreviations

CNC	Coefficient of Network Complexity
CPSS	Construction Project Success Survey
CSFs	Critical Success Factors
GDP	Gross Domestic Product
IMF	International Monetary Fund
IT	Information Technology
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
SMEs	Small Medium Enterprises
WHO	World Health Organization

1. Introduction

1.1 Background

The construction industry is essential for national economies' development, and it can be used to measure the overall growth of these economies. (Silva Susil, et al., 2015). Nevertheless, Construction is a competitive, complex and high-risk market where failures are increasingly reported (Ghoddousi & Hosseini, 2012). Hence, studying the critical factors in achieving project success is crucial and essential to improve the construction industry. Nevertheless, the majority of the previous studies focused on success in general without considering the project's attributes but just mentioning them as possible influencers over the success factors.

1.1.1 Construction Project Success

One of the commonly researched topics in construction management is project success. The conventional way of defining project success is the level of conformance between the predetermined aims and anticipations of the project with the actual project outcome, or simply, a project is successful when all the planned and expected results are achieved. (Moradi & Zanjirchi , 2012)

Some researchers argue that it is a challenging task to control the project and have a clear visualization of the outcome without setting the success parameters. Nevertheless, measuring the success of a construction project is problematic since different people can interpret success differently. (Lam, et al., 2008)

The traditional indicators of cost, time and quality remained the most common among all researches in this field. In addition, researchers emphasize that the success factors and the success criteria are different, likewise, the difference between project success and project management success. (Moradi & Zanjirchi , 2012)

1.1.2 Success Factors in Construction Projects

Project success factors can be defined as factors that effect, establish as well as determine the success of a project. These factors vary from country to country depending

on their particular operative environment, policies and legal limitation; therefore, they are not a typical set of factors that can be applied to all industry. (Silva Susil, et al., 2015)

Researchers have divided success factors into many sets of perspectives that are related to project outcome, project management, performing corporation, project team and exterior influences (Moradi & Zanjirchi , 2012). Other classification of project success factors can be done in two categories, one is hard, objective, tangible and measurable while the other is soft, subjective, intangible and less measurable. (Silva Susil, et al., 2015) success factors can also be divided into seven main groups that include factors that are related to project management, procurement, client, planning team, performing company, the project manager, and the environment. (Babu & Sudhakar, 2015)

The effort to determine the critical success factors is an ongoing topic approached by various scholars. In earlier project management literature, the focus was on identifying standard factors that contribute to projects' success. Within the last years, the authors emphasized the existence of different success factors depending on the project type. (Beleiu, et al., 2015)

1.1.3 Construction Project Categories

The stage of the project, the feature of the delivered outcome, the location, the duration, the complexity, the end users and stakeholders, the clients, the contractual environment and so forth are features, based on which the projects can be categorized. Every feature of these give the project special characteristics that employ a special management approach to achieve success in delivering the project. (Archibald, 2004)

For measuring project complexity, the literature provides three types of complexity measures. The first group is related to project management issues. The second group is related to a model of the project structure. The last group related to some holistic measures such as systems thinking oriented measures or informational measures. (Vidal, et al., 2011)

For measuring project size typically, the total project cost is considered. Some researchers divide the projects into small projects (that cost less than $5 Million and six months), medium projects (that range from $5 to $50 Million with a duration up to 12

months) and large projects (that have total costs that reach $500 Million and duration of 36 months). For mega projects, the cost exceeds $500 Million, and the duration is more than three years. (Josey & England, 2009)

1.2 Problem Statement

Many studies have been conducted to frame the success of the construction projects, determine the most efficient success criteria, and identify the most critical success factors. Researchers also introduced many methods of calculating success and many lists of factors. All these efforts were in attempting to avoid failure in construction projects, which despite all technology's advances and researches is still increasing.

However, construction projects vary in types, clients and many more attributes that make studying success for construction project generally without taking into account these attributes inefficient. Moreover, what is applied to one size of projects might vary from what is applied to another.

Therefore, a study that researches the projects' success based on their sizes is for a practical importance and it could also provide a result that might be used as a base for further studies in the same research direction, or an incentive to study success based on other project's attributes.

1.3 Research Questions and Goals

This research is conducted attempting to determine the factors that might be important for success in construction projects generally and then define the factors that are related with the size of the projects. Moreover, this research tries to define the nature of this relation and determine whether the results are conforming to what has been already introduced in the literature.

Therefore, the main goals and questions of this research might be summarized in the flowing:

1. Determining the state-of-art in the literature regarding construction project success.
2. What are the most important success factors?
3. Are success factors for construction projects interrelated?

4. How are the success factors changing between different project sizes?
5. Is there a relation between critical success factors and the size of the construction project?

1.4 Research Method

The methodology that was used in this research is thoroughly detailed and discussed in the third chapter of this thesis. Choosing positivism research philosophy is justified against research questions. Since this study tries mainly to uncover a possible relation between success factors in construction projects and the size of the project, the positivism approach was selected as the most appropriate philosophy, despite the fact that, the focus of this study is complex social aspects.

Since this research is studying how the success factors are related to each other and to the project size, cross-sectional research approach, when considering research time horizon, was compatible with this research. Moreover, using a survey strategy to collect the primary data, and the limited time of the research are also reasons to choose a cross-sectional approach.

Based on the idea that positivism philosophy was chosen, deductive analytical research approach was the most appropriate for this study. By using the deductive approach, the researcher is able to gather the recent knowledge in the subject area, and develop, test and analyze the hypothesis, in order to develop the current theory.

This research tries to identify a possible overall trend in relations between construction project size and the related factors that lead to success. Therefore, a combination of quantitative and qualitative methods was used, since these two approaches complete each other. Hence, this research is considered a multi-method quantitative study.

1.5 Structure of the Thesis

This thesis consists of five main chapters that start with this introduction. The next chapters and their main focuses are as follows:

Chapter two introduces a thorough literature review to provide a clear picture of the current situation of the construction industry in general and construction project man-

agement in specific, and to identify how projects are categorized. In addition, this chapter introduces success criteria and success factors from previous works and clarify the differences between construction projects' success factors and construction management's success factor.

Chapter three discusses the research methodology, which justifies the research philosophy and explains the total framework of the thesis. Moreover, the semi-structured interviews and the survey, which are the main tools used in this research to collect the primary data, are also detailed thoroughly in this chapter along with the pilot study.

Chapter four Analyzes primary data that was collected using the abovementioned tools. Moreover, determining success factors and the correlation between them and with the projects' sizes are the main part of this chapter.

Chapter five provides the conclusion of this research and the recommendations that might be important for future studies that will be conducted in this field.

2. Literature Review

2.1 Review of Construction Industry

2.1.1 Project Definition

Many definitions for a project can be found in the literature. A well-known definition of the project is that which Project Management Institute (PMI) had presented in the Project Management Body of Knowledge guide (PMBOK Guide), and it stated that a project is “a temporary endeavor undertaken to create a unique product or service.” (Project Management Institute, 2017)

Turner & Müller (2003) defined construction project as “An endeavor in which human, material and financial resources are organized in a novel way, to undertake a unique scope of work, of given specification, within constraints of cost and time, so as to achieve beneficial change defined by quantitative and qualitative objectives."

Other definitions of a project focus on the role of the project to create a result or a product through a sequence of multiple activities that use different types of resources, and all this to be conducted within predefined specifications with an exact beginning and finishing dates and limited budget. (Muller & Turner, 2003)

2.1.2 Current Situation of Construction Industry

“*Construction project teams must work together in true partnership and not as groups of disparate professions*” (Murray and Langford, 2003 cited by Al-Zahrani, 2013)

Construction can be viewed in both narrow and broad definition. The narrow definition that refers to the activities that take place in the construction site. While the wide definition, on the other hand, comprises also the production and distribution of building materials in addition to any other activity that is related to the industry. The construction industry is essential for national economies’ development, and it can be used to measure the overall growth of these economies. (Takim & Akintoye, 2002; Silva Susil, et al., 2015; Ghoddousi & Hosseini, 2012)

The construction industry is a competitive, complex and high-risk market where failures are increasingly reported (Ghoddousi & Hosseini, 2012). One reason that lays behind

the complexity of the construction industry is having many firms particularly comprised of small medium enterprises (SMEs) working together in one congested site (Fazli, et al., 2014). This complexity and instability nature of construction industry along with technological changes give the construction industry its dynamic nature (Ramlee, et al., 2015; Silva Susil, et al., 2015; Babu, 2015).

This industry faces many problems nowadays; these problems are mainly related to time, cost, quality, and safety (Nguyen, et al., 2013; Babu, 2015; Ribeiro , et al., 2013). In Portugal, a delay was reported in 40% of mega projects, and 14% of these projects faced budget overrun (Ribeiro , et al., 2013). Insufficient level of quality is one of the critical problems that occur in the construction industry today, and it can lead to up to 40% loss in contractor's profit (Mashwama , et al., 2017).

In 2008, it was reported that the total value of the global construction market yearly is $3200 billion. Moreover, an old estimation of the construction activities' value in the Gulf region was $1.5 trillion until 2007. Between 2011 and 2015, Malaysia spent $46 billion to improve construction market development. In 2014, the construction industry in Sri Lanka witnessed a growth of 20.0 Percent while it was only 14.4 percent in 2013. (Silva, et al., 2016; Silva Susil, et al., 2015)

The construction industry is the second contributor to the gross domestic product (GDP) in Saudi Arabia after the petroleum industry. Between 2008 and 2013, the government has spent about $574.7 Million on infrastructure. (Alhammadi, et al., 2016)

Construction industry faces different challenges related to risk and uncertainty in both developing and developed countries. However, these challenges in the developing countries are more severe and intense as they are related to lack of resources and lack of expertise to deal with critical issues in addition to the social, economic situations. (Salleh, 2009)

2.1.3 Construction Industry Challenges in Developing Countries

One of the essential roles that the construction industry plays in nations' development is employment since between 5% and 15% of the working force in developing countries is employed by this industry. About a third of the construction industry output in developing countries is residential buildings. A considerable proportion of the gross domestic product (GDP) is produced by the construction industry. Construction contribution

to the economy is related to its proportion of GDP and the Gross Domestic Fixed Capital Formation as well as its ability to create jobs. (Salleh, 2009; Ramlee, et al., 2015; Ghoddousi & Hosseini, 2012)

When there is an economic recession, the construction industry is the first to be influenced by it, which proves its instability. Despite its existence in both developed and developing countries, instability is more severe and intense in the latter. The demand in the construction industry is also unstable especially in developing countries, and it is profoundly affected by the economic situation of the market. This fluctuation affects the employment scheme. Since construction companies do not have stable demand in the market, they are not able to afford and keep skilled staff (Salleh, 2009).

As for resources, while many developing countries have sufficient natural resources, many of them have a lack of technical resources. Moreover, the industry there depends on the unskilled workforce. Which, despite being sufficiently available, affects the quality of the final output. In many developing countries, the actual cost of the construction project is often higher than the planned cost by about 30% of which 8.3% is dedicated to change orders. In addition, time overrun is one of the most severe problems that are facing the construction industry in developing countries as it was reported in Jordan for instance. (Salleh, 2009; Ghoddousi & Hosseini, 2012)

In some cases, developing countries are not able to fund massive projects. Therefore, they tend to get loans from different international entities such as the World Bank, the International Monetary Fund (IMF), the World Health Organization (WHO) and so forth. Many of these funds are based on the interest rate which increases the challenges facing the construction in developing countries. (Salleh, 2009)

2.1.4 Construction Industry in Europe and USA

In the USA, productivity increment existed in almost all industries except in construction whose productivity decreased between 1995 and 2001, despite the fact that, this industry uses about 40% of the energy, 30% of the raw materials and 25% of used water. The importance of the construction industry in the United States can be shown in its contribution to the GDP and the job opportunities created by this industry. In 2007, around 8% of the USA labor force (about 11 million workers and employees) had worked directly in the construction industry. Moreover, in the same year, construction

produced an outcome of $1.16 trillion. In general, the construction industry consists 4.4% of total GDP in the USA. (The Modular Building Institute, 2010) In 2013, The U.S. Census Bureau News expected that around $874 million would be spent on construction industry on different types of projects. (Rokooei, 2015)

Currently, the demand in the construction industry in all European countries is growing; this growth has reached a peak point, which it has never reached since 2006. Between 2014 and 2017, the outcome of the construction industry has climbed by 9%. However, it is expected that in 2020, for the first time since 2014, the growth of the renovation sector will be higher than the growth of new construction. The 84th EUROCONSTRUCT Conference expected that between 2017 and 2020 the highest growth in construction in Europe would be in Hungary then Ireland, Poland, Czech Republic and Portugal respectively. (ifo Institute, 2017) Figure (1) and Figure (2) shows the GDP and total construction output from 2014 to 2020, and "total construction output by sector from 2014 to 2020" respectively.

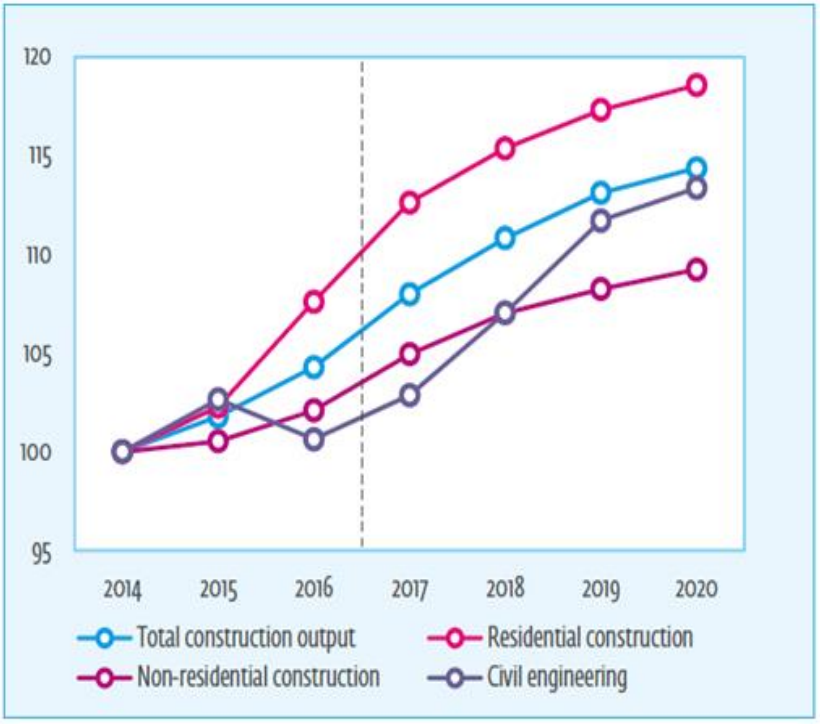

Fig. 1: Total Construction Output by Sector from 2014 to 2020 **(ifo Institute, 2017)**

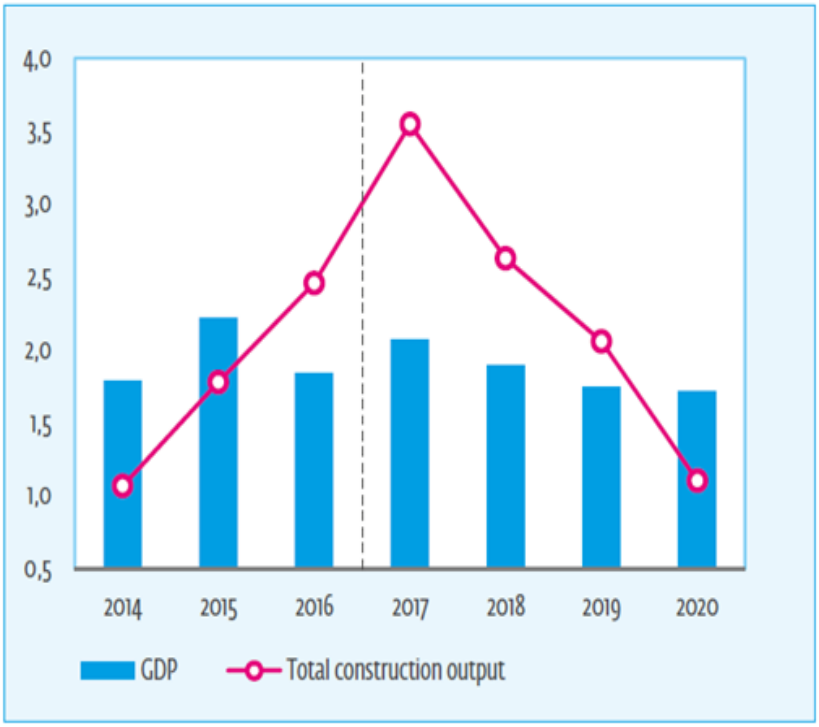

Fig. 2: GDP and Total Construction Output from 2014 to 2020 **(ifo Institute, 2017)**

Overall Europe, construction industry produces 10% of the GDP and 20 million jobs. In addition, it is one of the top consumers for energy and raw materials, and it is the highest influencing industry in European economy in regards to GDP and employment. (European Commission, 2012; European Commission, 2016; Ghoddousi & Hosseini, 2012) In 2011, the number of construction companies in the UK had reached about 253,121 company, and the total number of the private contractors is about 135,048 contractor. Moreover, the contribution of the construction industry to the UK's GDP in 2012 was £98.2 billion. (Al-Zahrani, 2013) In Finland, about 10% of the GDP is created by the construction industry. About 56% of overall investments in Finland in 2003 was construction investments (Salminen, 2005). Table (1) shows the change in total construction output in most of the countries in Europe.

TOTAL CONSTRUCTION OUTPUT							(% change in real terms)
Country/Year				Estimate	Forecasts		Outlook
	2014	2015	2016	2017	2018	2019	2020
Austria	-0,1	1,1	1,1	2,8	1,5	1,4	1,4
Belgium	1,5	2,3	3,7	2,5	3,7	2,3	3,5
Denmark	3,2	3,7	4,5	2,0	2,7	2,8	2,5
Finland	-1,9	0,9	8,6	3,5	1,4	-3,3	-1,3
France	-6,0	-2,0	2,6	3,6	2,7	2,3	1,2
Germany	1,8	0,2	2,5	2,6	0,9	-0,3	-0,4
Ireland	10,1	9,0	14,2	14,6	12,7	7,9	5,2
Italy	-2,2	0,9	1,1	1,0	2,0	1,8	1,6
Netherlands	0,5	7,7	5,8	5,4	4,9	3,8	2,6
Norway	2,3	-0,1	5,2	6,8	3,5	2,5	1,8
Portugal	-1,0	3,5	-1,5	6,0	5,0	5,0	4,0
Spain	-1,7	2,9	1,8	4,1	3,8	3,7	3,0
Sweden	7,7	6,1	5,8	9,9	3,6	0,0	-3,2
Switzerland	3,5	1,7	0,9	1,6	2,5	1,9	0,7
United Kingdom	9,3	4,0	3,9	2,7	0,7	1,9	0,2
Western Europe (EC-15)	**0,9**	**1,6**	**3,0**	**3,3**	**2,3**	**1,7**	**1,0**
Czech Republic	4,1	7,1	-5,8	1,6	5,0	6,7	2,5
Hungary	6,5	3,4	-19,3	25,5	21,4	7,9	1,4
Poland	4,7	4,0	-4,5	8,7	9,0	10,3	4,2
Slovak Republic	-3,5	18,5	-11,4	3,1	1,8	0,4	-0,5
Eastern Europe (EC-4)	**4,3**	**5,4**	**-7,1**	**8,6**	**9,3**	**8,7**	**3,2**
Euroconstruct Countries (EC-19)	**1,1**	**1,8**	**2,5**	**3,5**	**2,6**	**2,1**	**1,1**

Tab. 1: Change in Total Construction Output in Europe (ifo Institute, 2017)

2.2 Project Categorization

The categorization of a project can occur based on the many features of a project. These features include but not limited to the stage of the project, the feature of the delivered outcome, the location, the duration, the complexity, the end users and stake-holders, the clients, the contractual environment and so forth. Every feature of these give the project special characteristics that employ a special management approach to achieve success in delivering the project. (Archibald, 2004)

Most of the literature in project management discuss the principles, tools, techniques, and processes of project management in general without taking into account that, de-spite general rules of project management could be applied for almost all construction project, yet for different projects there will be special management approaches based on the classification of the project. (Archibald, 2004)

Archibald (2004) proposed to divide the projects into main categories and four level of sub-categories and deal with the projects based on that.

2.2.1 Project Complexity

Finding a specific definition for project complexity is very challenging, however, in some literature complexity is defined as the feature of the project that makes the project difficult to understand, expect, anticipate, and under control. (Vidal, et al., 2011)

For measuring project complexity, the literature provides three types of complexity measures. The first group gathers measures that relate to the computational complexity of some project management issues, such as the sequencing and scheduling problem. The second group gathers measures that are related to a model of the project structure as a graph such as the Coefficient of Network Complexity (CNC). The third group gathers more holistic measures such as systems thinking oriented measures or informational measures, for instance, the traditional static entropic measurement of complexity. (Vidal, et al., 2011)

2.2.2 Sizes of Construction Project

Classifying projects by size is typically measured by total project cost. Similar to project complexity and other types of project classification, there is no common and agreed method in categorizing the project based on size. However, Josey & England (2009) classified the project into small, medium, large, and Megaprojects. They also associate project duration with each of these categories. For example, small projects are the projects that cost less than $5 Million and six months, whereas, medium size projects range from $5 to $50 Million with a duration up to 12 months. Large projects, on the other hand, have total costs that reach $500 Million and duration of 36 months. For mega projects, the cost exceeds $500 Million, and the duration is more than three years. (Josey & England, 2009)

Crawford, et al., 2002, on the other hand, divided the sizes of the projects using:

- **The total project costs**: they divided the projects into small and medium projects (less than $10 Million), large size projects (range from $10 to $100 Million), and major projects (more than $1000 Million).

- **The percentage from the total turnover of the parent company**: they divided the projects into small projects (around 0.1% of company turnover), medium projects (around 1% of company turnover), large size projects (around 10% of company turnover), and major projects (around 100% of company turnover).

2.3 Construction and Project Management

2.3.1 Role of Project Management

Project management is the implementation of related methods, techniques, tools and skills in the various project's activities to achieve the project goals in time, within the budget and with required quality to achieve specific stakeholders' satisfaction. (Silva Susil, et al., 2015; Kjær, 2009)

Determine the goals of the project is one of the project management tasks, its duties also include defining the required tasks to achieve these goals and the most relevant project's milestones in addition to organization planning, resource allocation and planning and schedule planning. Hence, project management is a mean to avoid project failure. (Nwachukwu & I. Emoh, 2011; Kashiwagi & Rivera, 2016) Some of the most important supporting processes in construction management are using the new management tools and methods in addition to risk and value management. Successful project management requires skills that enable, along with experience, to decrease risk and increase the possibility to achieve success. (Al-Shibly, et al., 2013)

Effective communication and interaction is one of the most important aspects of successful project management. Clarifying complex problems, build up a plan to overcome challenges and searching for the root cause of every problem are also playing a considerable role in measuring the performance of project management. (Salminen, 2005)

2.3.2 Role of Project Manager

Project managers are experienced professionals who can manage and control the projects' processes and the coordination between different stakeholders; they are also responsible for leading the project team, the decision-making processes, estimating and planning cost, time and materials, and schedule planning. One of the things that

make the task of the project manager difficult to achieve is the size of the project. The bigger the project is, the more difficult it is to arrange, organize, manage and allocate resources. (Nwachukwu & I. Emoh, 2011; Kashiwagi & Rivera, 2016)

Managers of the construction project, to lead successfully a project, have to know the latest methods in the management field in addition to their knowledge of all construction activities, processes and latest methods and technologies. Project managers should decide who is doing what, how and when; they also manage all knowledge areas of project management. (Rokooei, 2015)

The project leader has to plan, control and manage the interrelations between different stakeholders, cost predictions and time while optimizing the resources and materials. The project manager always tries to deliver the project on time under budget while meeting the expectations of the different stakeholders. Despite the raised number of project management certificates and project management education over the past decade, still, the project managers are not able to deliver the project within the desired goals. The difficulties that the projects' managers face are the results of various reasons. Complex services, expanded supply chain, megaprojects, the vague rule of stakeholders and so forth make successfully managing construction projects a big challenge. Unclear stakeholders and clients' requirements often result in changing the project scope; also, the high level of required details could result in less transparent work, which results in attempting to solve problems just when they appear. (Rivera & Kashiwagi, 2016)

2.3.3 Characteristics of Successful Project Managers

A study carried out by Salminen in 2005 shows that managers within a specific effectiveness level have common and similar characteristics. The level of effectiveness according to this study was ranging from how many companies have the manager worked for, the educational state, how the work is satisfactory, and the leading type. On the other hand, the project managers affect their team members through assigning challenging tasks, effective use of authority, personal characteristics, ability to peruse, and using of the rewarding scheme. Additionally, the study showed that when "being in power in the company" was the focus of the manager, his effectiveness and results were low; in contrast, the outcomes were better when the project management is more

project oriented. However, the outcome of all these studies is still questioned since all these studies where carried out by asking the objective groups or their coworkers and are not built on solid comparable measures. (Salminen, 2005)

2.3.4 Characteristics of Successful Project Management

A study carried out by Dulaimi and Langford (1999) examined a sample of 57 project managers to search how their attitude contribute to their influence over the project. The managers' attitude was described in five groups that are the ability to manage the resources of the project, being organized and able to coordinate, the ability to work with information, motivating and able to handle disputes in the project. The study also found that the time and cost achievement of a project could be independent of the behavior of the manager.

The efficiency, effectiveness, quality, profitability and personal traits are the main references measures to which the performance of project management can be evaluated. In addition, the most important characteristics of the project management are the ability to motivate project stuff, communicate and build strong communication booths, priorities health, and safety, build teams, take suitable timely decisions and build performance plans. (Salminen, 2005)

The main challenges that facing the current measures for project management assessment is that they focus on the corporation's maturity or the personal knowledge of the project manager.

2.3.5 Tools to Evaluate Project Management

The main tools to evaluate the project management performance are (Sanjuan & Froese, 2012):

Balance Scorecard-ROI that generate goals and parameters in "financial, internal business, innovation, and customers" to enhance management decision.

The maturity-based metric that concentrates on finding out the maturity of the project management and binding it with the objectives of the project regarding budget and schedule.

Resource-Based Measures that measure the company's in-house competencies as it plays an important role in the enduring and durability of the firm.

It is difficult to evaluate or determine the best project management practices; however, many project management standards are accepted and recognized all over the globe as benchmarks. Some of these standards are (Sanjuan & Froese, 2012):

Project Management Body of Knowledge (PMBOK) it divides project management into nine "knowledge areas" and five types of "process groups" that take place within the knowledge areas. The process is defined by its inputs, tools and techniques, and outputs. One of the most important "knowledge areas" is the integration area where all the other areas are incorporated and where the project agreement, the project management plan and the closing of the project are developed.

International Project Management Association Competence Baseline consists of many "competence elements" that are divided into contextual, technical and behavioral competencies. The eleven elements of the contextual competencies deal with the direction of the company's portfolio and programs within the strategy. It also includes the different aspects that are in direct relation with the company. The fifteen elements of the behavioral competencies describe the characteristics that the project manager should have to enhance the project success. The twenty elements of the technical competencies are related to the project management methods and practices and other supporting procedures.

Prince2 a technique that is the result of the knowledge and practices from both successful and failed projects. It focuses more on the duties and positions within the project. Prince2 implement management techniques in phases within predefined limitations of nonconformity regarding time, cost, quality, and scope. This technique divides the project management into themes, which are almost alike with the knowledge areas that the *Project Management Institution* is using.

2.4 Project Success

2.4.1 Construction Project Success Overview

One of the commonly researched topics in construction management is project success. The numerous reports that conducted in this area have focused on the factors that lead the project to achieve success and how can these factors be achieved. Moreover, some researchers argue that it is a challenging task to control the project and have a clear visualization of the outcome without setting the success parameters. That being said, measuring the success of a construction project is problematic since different people can interpret success differently, particularly, when the definition of success and its measurement are not clear or precise. (Lam, et al., 2008)

Because researchers are unable to determine and agree on a set of success factors, they tried to take into consideration the critical factors. Nevertheless, the traditional indicators of cost, time and quality remained the most common among all these researchers. In addition, there was an emphasis on the importance of distinguishing between the success factors and the success criteria, likewise, the difference between project success and project management success. (Moradi & Zanjirchi , 2012)

2.4.2 Project Success Definition

Project success was defined differently over time. In the sixties, success was purely practical, and the project is successful when the final outcome is operating correctly. The eighties introduced what today is called “conventional” success criteria (cost, time, quality), without including any external criteria that relate to a client or a stakeholder, which was not introduced until late 80s. (Khosravi & Afshari, 2011; Moradi & Zanjirchi , 2012)

Despite the various endeavors by researchers to have a specific definition for construction project success, the current definitions vary and even contradict in between each other. However, the conventional way of defining project success is the level of conformance between the predetermined aims and anticipations of the project with the actual project outcome, or simply, a project is successful when all the planned and expected results are achieved. (Moradi & Zanjirchi , 2012)

Some resources stated that “The project is considered an overall success, if the project meets the technical performance specifications and/or missions to be performed, and if there is a high level of satisfaction concerning the project outcome among key people in the parent organization, key people in the project team, and key users or clientele of the project effort.” (De Wit’s, 1988 cited by Al-Zahrani, 2013)

2.4.3 The success of Project and Project Management

Even they might sound similar, yet project success and project management success are very different. The former is focussing on the final product, profit, client’s satisfaction and organizational goals. Whereas, the latter is related to the management methods, traditional parameters of time, cost, and quality in addition to management processes and shareholders' satisfaction. In some cases, the success of project management was interpreted as a measure of productivity within the performing company, and project success is the external. (Shokri-Ghasabeh & Kavousi-Chabok, 2009; Moradi & Zanjirchi , 2012)

Project success and project management success are interrelated and affect one another. Despite its effect on project success, project management might not be capable of avoiding project failure.

2.5 Project Success Criteria and Parameters

The project success parameters are correlated variables by which the project success can be evaluated. These parameters have developed through time from only “time, cost and quality” to include later on other indicators such as fulfillment of client’s expectations and efficiency. Some researchers tried to produce a full picture of these parameters by dividing them into four groups that related with the effectiveness of the project, the influence of the customer/client, the success of the company and the readiness for the future. (Takim & Akintoye, 2002; Silva, et al., 2016)

Researchers emphasize in differentiating between the factors that evaluate success, which is called “Success Criteria”, and the factors that enhance the success of the project, which is called “Success Factors”. (Shokri-Ghasabeh & Kavousi-Chabok, 2009)

Project success parameters help in developing a consensus on the stage and the way by which the project success will be evaluated, which, consequently, lead to mutual understanding of the project delivery and consequently enhance success as it lines up the objectives of the project team and strengthens their commitment. Some researchers concluded that defining these success parameters at the beginning of the project is a “good project management practice.” (Hussein, 2013)

2.5.1 Previous Studies Concerning Success Parameters

A study conducted in the UK to identify the key performance indicators in a construction project has recognized seven success parameters that are directly related to the construction project and three others that are related to the organization. The project-related parameters are project cost, project duration, cost forecast, schedule forecast, deficiencies, customer satisfaction with the result and customer satisfaction with the process. The company-related parameters are safety, cost-effectiveness, and efficiency (Tab. 2). All these parameters are outcome-oriented except for cost forecast and schedule forecast, which probably are driven by the procurement; safety indicator,

Construction project related factors	Project cost
	Project duration
	Cost forecast
	Schedule forecast
	Deficiencies
	Customer satisfaction with the result
	Customer satisfaction with the process
Organization related factors	Safety
	Cost effectiveness
	Efficiency

Tab. 2: key performance indicators in construction projects (Takim & Akintoye, 2002)

on the other hand, is connected with the process within the project. (Takim & Akintoye, 2002)

Research conducted at Texas University has developed a six-criterion system for project evaluation, these consist of cost performance, time performance, fulfillment of client expectation, fulfillment of project manager expectation, fulfillment of contractor ex-

Cost performance
Time performance
Fulfillment of client expectation
Fulfillment of project manager expectaion
Fulfillment of contractor expectation
Proejct's performance

Tab. 3: Texas University's Project evaluation criteria (Nguyen, et al., 2013)

pectation and project's performance (Tab. 3). Other studies conform to the aforementioned success measure criteria with an additional focus on the project's quality; this resulted in adding other criteria that are related to pre-determined project's specification and quality of work. (Nguyen, et al., 2013)

Within a decade, (1990 to 2000) further studies were conducted in an attempt to determine project success criteria. These studies stated different success indicators that can be divided into *objective-related* and *subjective-related* indicators. The objective-related indicators deal with cost, time, safety, quality, specifications fulfillment, efficiency, and yields, whereas the subjective-related indicators deal mainly with one theme and that is the satisfaction of the stakeholders of the project. (Nguyen, et al., 2013)

Griffith and a group of researchers (1999) introduced a calculation for success indicators in facility projects, they considered four indicators, and weighted them differently; they took into account the deviation of the actual values of these indicators from their planned or authorized values. Cost performance was the most critical indicator and had 33% weight in assessing success followed by schedule performance with 27%. In addition, they considered two other parameters; these were: how the design of the building accord with usage and how efficient the operation was. These two parameters

were measured after half a year of operation, and they had the weight of 12% and 28%. (Griffith , et al., 1999)

Shawn and a group of researchers (2004) developed a tool that was called “Construction Project Success Survey” (CPSS). This tool comprises the traditional parameters for project success such as schedule performance, budget performance, health and safety and quality. For the evaluation of the parameters, they used “7 points Likert system” and calculated the significance of each parameter. (Shawn , et al., 2004)

Menches and Hanna conducted a quantitative evaluation procedure for success parameters; they delivered the quantitative procedure from the qualitative one. They chose six parameters; these parameters were: project revenue, time performance, the duration required for the whole project, the interaction between project members, cost performance and changes duration. However, the conducted research shows the parameters that concern mainly the contractor, but the research did not cover all the points that might concern the project’s owner. (Menches & Hanna , 2006)

The factors that facilitate success differ among diverse projects. Likewise, the evaluation of success differs from one project to another, since the interests of the people and organizations involved in and related to an exact project are not the same and the environment that is surrounding a project might be different from the environment surrounding another project. For instance, a week extension of an IT project longer than the original schedule could turn out to a tremendous failure when another IT project achieves relatively same result during that week. In contrast, the same week extension time probably does not have much effect on the success of a residential building project. (Shokri-Ghasabeh & Kavousi-Chabok, 2009)

In 2011, Khosravi and Afshari introduced a model to calculate and evaluate construction project success. The model considers five project success parameters that are related to time, cost, quality, safety and client’s satisfaction. These parameters were developed by conducting two-rounds questionnaire, in which experts in the field of construction projects participated. From the questionnaire, the top five scored factors were chosen to be used in the model. Table (Tab. 4) below shows these five factors ranked based on the questionnaire. (Khosravi & Afshari, 2011)

Project Success Criteria	Average Score	Mean Rank	Rank	Description	Result
Time Performance	4.94	13.72	1	Meeting time objectives for key milestones	Selected
Cost Performance	4.67	11.94	3	Meeting cost objectives for the project	Selected
Quality Performance	4.61	12.13	2	Meeting quality objectives for the project	Selected
HSE	4.44	10.77	4	Health, safety & environment of the project	Selected
Client Satisfaction	4.28	9.58	5	Client's overall satisfaction of the project	Selected

Tab. 4: Top-ranked project success Criteria **(Khosravi & Afshari, 2011)**

2.5.2 The Necessity for Success Parameters:

Through the past years, researches have stressed the importance of having a clear set of success parameters. They argue that having this set will direct all construction project participants, it will lead to better management and allocation of the company's resources, especially in the projectized companies, and it will facilitate continuous processes. Nevertheless, using the traditional criteria that are represented in time, cost and quality are not adequate anymore. In contrast, different parameters become important such as safety, client's satisfaction and so forth. (Lam, et al., 2008)

Diallo and Thuillier, in their study, gave more importance to the traditional way of evaluating project success. They also noted out that, one of the most difficult evaluation factors is evaluating the quality of the outcome and the processes throughout the project. Other researchers argued that performing affectivity, business and individual growth are also crucial. (Diallo & Thuillier, 2004)

2.5.3 The Risk in Determining Success Criteria

There will be a risk at the beginning of the project while determining the criteria of success and its definitions, or while conducting the evaluation and assess the project the success. These risks and threats can be categorized as follows (Hussein, 2013):

***Set narrow criteria**:* when the Parameters are narrow and focusing only on the project, this can lead to the deviation between the project and the organization that performs the project. Consequently, the project will lose the commitment and the support from the higher management where management support in itself is a factor that contributes to success.

***Unclear success criteria**:* unclear parameter can be understood differently among the project team for instance which might disturb the focus or the resources distribution. Moreover, controlling unclear Parameters is quietly difficult, and it can be misleading during the project evaluation time. Hence, researchers have provided several instances for unclear parameters such as the parameters that are relating with a degree of satisfaction, or safety and so forth.

***Multiplicity and variety**:* Success parameters may vary and contradict because of the different expectations and effects of shareholders who might differ from each other in knowledge, education, background, culture and so forth. This variation can lead to difficulties in setting up project success parameters that accommodate this diversity.

***Inadequacy**:* shortage in information about stakeholders or influencing entities, as well as the lack of information about the final product can result in setting up success parameters that do not reflect fully the optimum method in evaluating success.

***Alterations**:* one of the most common challenges that face the construction industry is the changes that come so frequently during the planning or execution phase. In addition, many changes cannot be avoided especially when it is related to regulations. These changes reflect a high level of risk.

***Choosing Unrealistic criteria**:* in various situation companies and clients are enthusiastic about the project and choose goals that are close to perfection. Consequently, if the result of the project was close to optimal, the project in evaluation is still failing since it did not achieve the goals.

2.5.4 Success Parameters Grouping

Currently, researchers are not able to have an agreed set of project success parameters or criteria; they also have different approaches to conduct the measurement of these parameters, especially when there is a significant number of stakeholders who have a different understanding of success. (Seresht, et al., 2014)

Babu and Sudhakar researched in 2015, and they emphasize the need of having one global list of success parameters that can be a reference for all projects. Nevertheless, they divided the success parameters into five groups that include:

***Client-related parameters**:* that may include the three traditional success criteria (cost, time, and quality), functionality and returns, when the client is the owner.

***Planner-related parameters**:* planners are more interested in satisfying their clients, in addition to the time performance and yields. Also, reducing the issues that face the project during construction, as well as the social acceptance of the work.

***Contractor-related parameters**:* that may include the three traditional success criteria (cost, time, quality) and other parameters that relate to safety, a minimal number of charges and earnings.

***General Parameters**:* these are the shared parameters between the abovementioned groups. That range from having an excellent, reliable commonly-agreed-on schedule that can be used to measure success, in addition to, delivering the project within budget without any legal penalties and disputes.

***Individual parameters**:* the parameters that differ between the owner, the designer and the contractor. For instance, safety can be more critical for the performance company, while having a functional output, for example, is the more important for the owner.

On the other hand, some researchers divide project success parameters into two main groups that are before and after project completion. They highlight some parameters that are: cost, time, quality for “Before” evaluation, and information scheme, achievements of the organization and achievements of stakeholders for “After” evaluation. *The information scheme* includes the ability to maintain, validate and rely on the information. While, the *achievements of the organization* related directly to the increased productivity and yields, decrease waste, long-term goals, and learning goal. On the other hand, *achievements of the stakeholders* can be connected with meeting the users’ expectation, the effect on society, the ecological effect and personal improvement and so forth. (Khosravi & Afshari, 2011)

Moreover, success parameters and measures can be divided into two groups, one has a narrow look at the project, and the other one has a broader view. The former group includes parameters such as budget, duration, quality, health, and safety at the end of the project. While the latter group includes parameters such as meeting client’s expectations, utilization of the project, process of running the project. However, all these

parameters are relatively related to a certain point in time, and they do not have continuity. (Khosravi & Afshari, 2011)

Another possibility to divide the success parameters is into three different groups. The first group includes the parameters that have a close relationship with the company in general such as performance and effective use of resources. The second group consists of the parameters that are in close relation with the project such as meeting the client's expectation. Parameters in the third group are related individual parameters such as meeting personal expectations. (Khosravi & Afshari, 2011)

2.6 Project Success Factors

2.6.1 Definition of Success Factors

Project success factors can be defined as factors that effect, establish as well as determine the success of a project. Other definitions can be as "inputs to the management system" that lead directly or indirectly to the success of the project. Critical success factors can also be defined as those comparatively small quantities of truly essential matters where a specific business should emphasis its attention in order to achieve success. However, Critical Success Factors (CSFs) will definitely vary from country to country depending on their particular operative environment, policies and legal limitation, which means, they are not a typical set of factors or criteria, which can be applied to all industry. (Silva Susil, et al., 2015)

2.6.2 Grouping Success Factors

To reach a common methodology, many researchers have divided success factors into many sets of perspectives that are related to project outcome, project management, performing corporation, project team and exterior influences (Moradi & Zanjirchi , 2012). Other classification of project success factors can be done in two categories, one is hard, objective, tangible and measurable while the other is soft, subjective, intangible and less measurable. (Silva Susil, et al., 2015)

Another way to group the project success factors is to divide them into seven main groups that include factors that are related to project management, procurement, client, planning team, performing company, the project manager, and the environment. (Babu & Sudhakar, 2015)

For some researchers, construction projects' success factors fall into four dimensions. First is meeting the design's objectives, which refers to the agreement that was contracted with the customer. The second dimension is the value to the end users, which refers to the value to the customers from the project end products. The third dimension is the value to the developing company and refers to the benefit gained by the company as an outcome of performing the project. The last dimension is the value to the national technological infrastructure, as well as to the technological infrastructure of the firm that was engaged in the development process. (Silva Susil, et al., 2015)

2.6.3 Previous Studies Concerning Success Factors

The effort to determine the critical success factors is an ongoing topic approached by various scholars, especially due to the pressure of implementing successful projects in a dynamic global market and changing business world. In earlier project management literature, the focus was on identifying standard factors that contribute to projects' success. Within the last years, the authors emphasized the existence of different success factors depending on the project type. (Beleiu, et al., 2015)

Babu and Sudhakar conducted a study in 2015 to systematically investigate the causes of project failure and how these can be prevented, managed, or controlled. They argued that the critical success factors within the Project are:

- Project Mission
- Top Management Support
- Project manager's competencies
- Project schedule and plan
- Client consultation
- Project team members' competencies
- Quality of suppliers and subcontractors
- Technical tasks
- Client acceptance

- Monitoring and feedback
- Communication
- Troubleshooting.

Earlier in the same year, Babu (2015) has published a paper identifying the critical success factors in the project as shown in the table (Tab. 5) below.

S.NO	FACTORS
1	COST FACTORS
2	TIME FACTORS
3	QUALITY FACTORS
4	PRODUCTIVITY FACTORS
5	CLIENT-SATISFACTION FACTORS
6	REGULAR AND COMMUNITY SATISFACTION FACTORS
7	PEOPLE FACTORS
8	HEALTH & SAFETY FACTORS
9	INNOVATION & LEARNING FACTORS
10	ENVIRONMENT FACTORS

Tab. 5: Factors affecting the success of a construction project (Babu, 2015)

Chan et al. developed in 2004 a conceptual framework that included and regrouped variables affecting project success. They selected seven major journals in the construction field to analysis the previous works on project success. Five main groups of variables, namely project-related factors, project procedures, project management actions, human-related factors, and external environment are identified as crucial to project success. Figure (3) illustrates the framework that was developed by Chan et al.

A study by Gudiene et al. in 2013 developed a conceptual model that includes the grouped critical success factors affecting project success. It included seven major groups of factors, namely external factors, institutional factors, projects related factors, project management/team member's related factors, project manager related factors, client-related factors and contractor related factors influencing the project success in Lithuania. The variables within each group are interrelated. A variable in one group can influence a variable in the others. Figure (4) shows the Conceptual critical success factors model for a construction project that was developed by Gudiene et al.

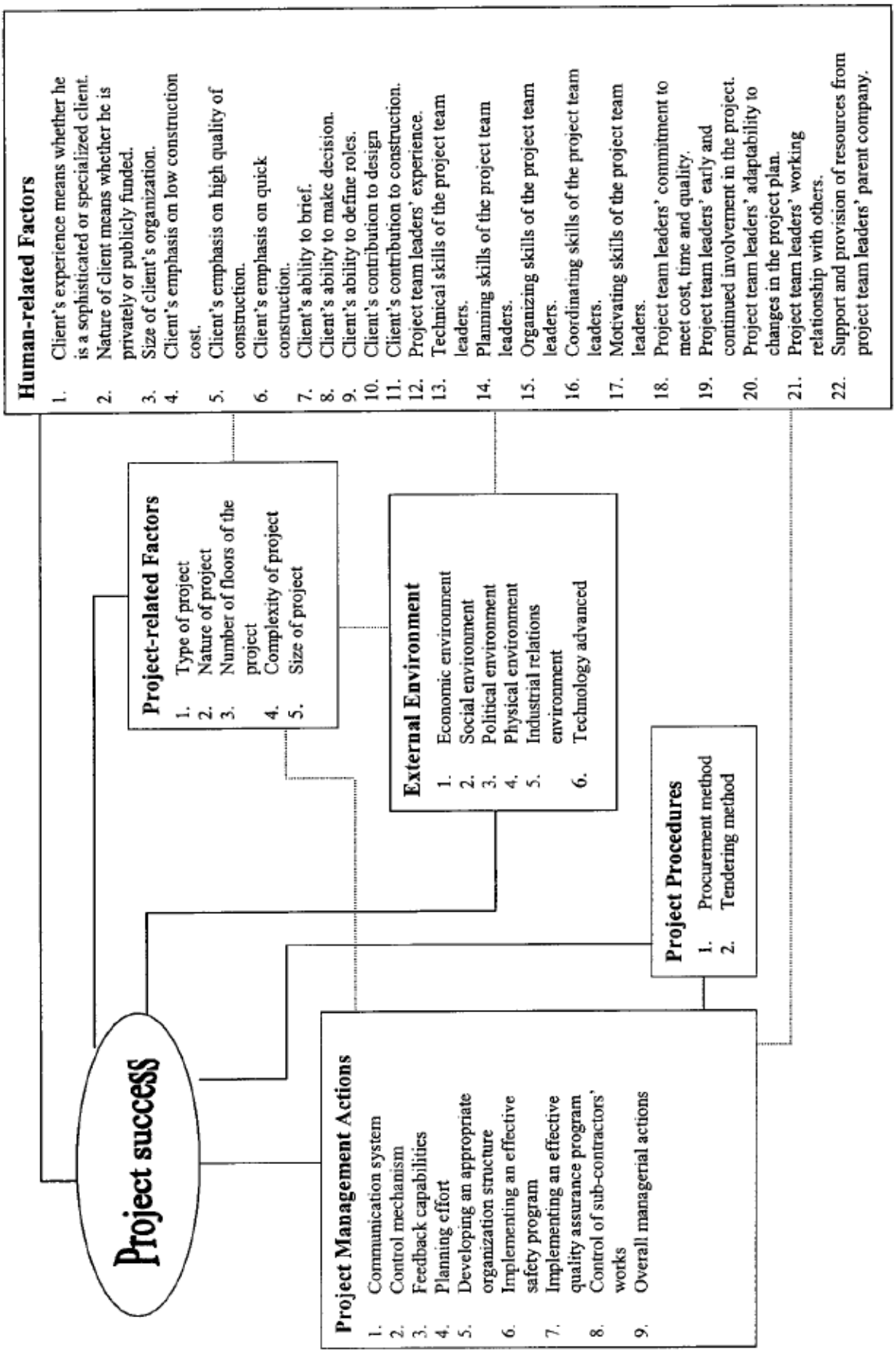

Fig. 3: A new conceptual framework for factors affecting project success (Chan, et al., 2004)

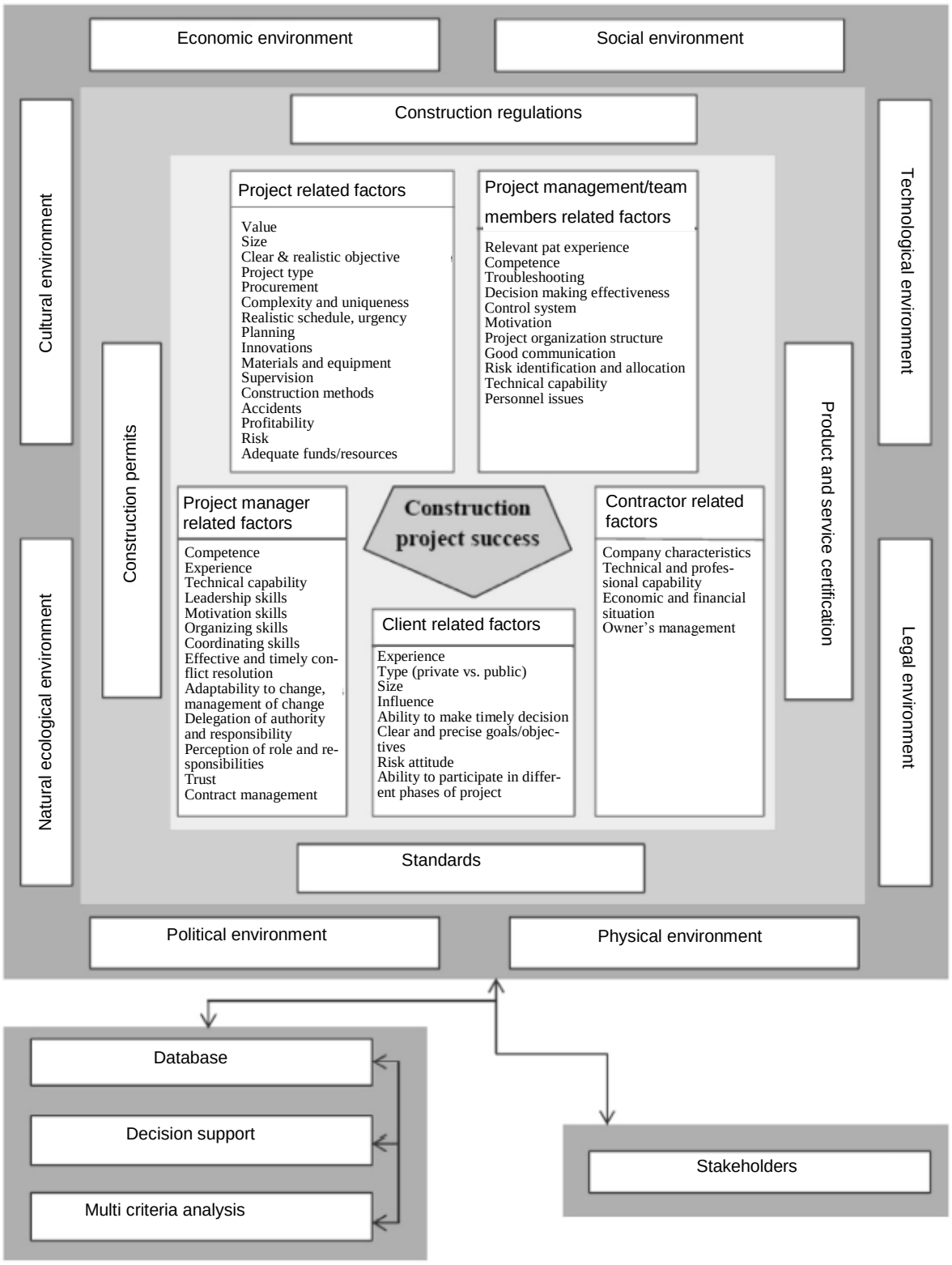

Fig. 4: Conceptual critical success factors model for construction project (Gudienėa , et al., 2013)

Maghsoodi and Khalilzadeh have defined in 2017 the critical success factors via a survey of the literature. After that, they prepared a questionnaire concerning the criteria such as time, cost, quality, and safety, which are considered the measurements of the success and failure of the projects. This questionnaire was distributed to the professionals and experts of the construction industry that form the statistical population to determine the percentage of approval and the importance of each criterion. Next, they used the Fuzzy TOPSIS multiple criteria decision-making methods to rank the critical success factors of the construction projects. Finally, they compared the proposed method with Entropy-based Fuzzy Multi-MOORA. The result of the research is ranked critical factors affect the successful execution of Iran's construction projects as shown in the table (Tab. 6).

Critical success factors of the project
Strategic and effective planning of project
Allocating appropriate funding
Experienced and multidisciplinary project team
Availability of resources
project monitoring and control mechanism
Qualified and experienced project management
Tender awarded to competent contractors
The urgency of completing the project
Accurate and reliable estimates of project costs
Complete and clear of contracts and project goals
Senior management support of the project
Commitment to the project
Prediction of project risks
Regulations and political or economic and social issues
Having contact with stakeholders and all the people in the project
Ongoing consultation of the project employer

Tab. 6: Critical success factors of the project calculated by the fuzzy topsis method (Maghsoodi & Khalilzadeh, 2017)

Homthong and Moungnoi carried out a study in 2016 to define the CSFs that influence construction project performance, and determine their relative importance for different objectives across five stages in the project life cycle. In the beginning, they developed a set of factors based on a thorough literature review. Next, a questionnaire survey, based on 179 identified factors, grouped into nine major factor categories, was conducted to collect data from three groups of respondents: client representatives,

consultants, and contractors. Using the mean score, relative importance index, and the weighted average method, they defined the top 9 critical factors for each category. The survey findings indicate that the most CSFs in each category in the operational and maintenance phases are as shown in the table (Tab. 7).

Performance Group	Critical success factors
Time	Project participants' competence
Cost	Relationship among project participants
Quality	Effective quality assurance system in organisation
Health and Safety	Interrelation between the employee and supervisor
Environment	Regular maintenance of equipment for the project
Productivity	Competent supervisors
Risk management	Quality of works to match standards
Human resource	Positive attitude of employees
Client satisfaction	Durability of the completed work

Tab. 7: The most critical success factors (Homthong & Moungnoi, 2018)

Shokri-Ghasabeh & Kavousi-Chabok, 2009 carried out a thorough literature review of project success factors and project success criteria, followed by a thorough questionnaire. The questionnaire was a multi-purpose set of questions, which comprised of 11 sections. The results of a survey, conducted by the researchers, show that "Top Management Support" turned out to be the most important measure of project success followed by Project Control, Stakeholders satisfaction, Risk Management, Project Change, and Resource Availability. "Time" and "Quality" and their process, on the other hand, were not considered as critical success criteria but as criteria for evaluating projects.

Salleh researched in a doctoral thesis submitted to Queensland University of Technology in 2009 the problem of delays in the construction industry in Brunei and tried to identify success and delay factors which can help project parties reach their intended goals with greater efficiency. This research extracted the most important success factors according to the literature and the most important delay factors

identified by project parties and then examined correlations between them to determine which were the most influential in preventing project delays. The success factors that were identified by the study were project manager capabilities, clarity of project scope and work definition, organizational planning, use of control system, project manager's goal commitment, project team motivation and goal orientation, and safety precaution and applied procedure. (Salleh, 2009)

Beleiu et al. presented article in 2015 that aims to identify main success factors when dealing with projects using a quantitative research. The research combines the literature review with a quantitative empirical study on success factors in order to determine the top five factors that have the highest influence on projects' success. In the end, the factors that were determined in this study are clearly defined goals and directions, competent project team members, clearly defined roles and responsibilities, communication and consultation with stakeholders, and compliance with the planned budget, time frame, and performance criteria. (Beleiu, et al., 2015)

3. Research Methodology

In this chapter, the methodology that was used in this research is thoroughly detailed and discussed. The first part of this chapter is discussing the research philosophy. It gives an overview of different types of possible research philosophies and justifies the decision on positivistic philosophy in this research.

This chapter also provides a summary of researches' types when time horizon to be considered. It shows when and why each research type might be used and justifies choosing of cross-sectional research approach in this research.

The next part of this chapter details the research framework. How it was chosen and processed. While discussing the research framework, the researcher also provides a justification for choosing the research tools and the deductive research method. These tools, which were used in the research to collect data are explained and justified. An overview illustration of the whole framework is also presented in this chapter.

After that, defining the primary and secondary data is presented. This chapter details how the primary data was collected and what is the secondary data and how it was dealt with. In addition, the tools to collect the primary data are explained in terms of why it was chosen and how it was employed. Moreover, deciding on the population, sampling and sample size was introduced and justified.

The stages in which this research was carried out in this research were thoroughly detailed in this chapter. These stages are:

1. Literature review.
2. Identifying success factors.
3. Design semi-structured interviews.
4. Questionnaire.
5. Analyzing and conclusion.

This chapter presents the argument behind choosing the project success criteria (cost, time, quality, and client's satisfaction) in the questionnaire.

Assessing the validity of the questionnaire in addition to the research limitations are presented at the end of this chapter.

3.1 Research Philosophy

The researcher has to develop a throughout understanding of the subjected area and its basics in order to use the appropriate philosophy since it has a great influence on the whole methodology outlines (Saunders, et al., 2009). Therefore, choosing research philosophy affects the research methodology as well as the way in which the data will be collected, and how these data will be analyzed in addition to the delivered conclusion.

While some researchers agreed that positivism and interpretivism are overlapping in many cases, many of them believe that these two philosophical patterns are contradicting each other (Bryman & Bell, 2003; Saunders, et al., 2009). In the positivism method, researches consider the social world as multiple processes, and they try to implement the natural approaches to develop rules and relations usually by facilitating statistical analysis as the main tool. (Saunders, et al., 2009)

In contrast to positivism, interpretivism philosophy counts natural science approaches as inapplicable to social processes and people. They argue that business conditions are complicated, interrelated and mainly individual. In addition, the current instability characteristic of the business environment makes most of the conducted researches outdated. (Saunders, et al., 2009)

Since this study tries mainly to uncover a possible relation between success factors in construction projects and the size of the project, the positivism approach was selected as the most appropriate philosophy, despite the fact that, the focus of this study is complex social aspects.

3.2 Time Horizons

Regarding time horizons, Saunders et al. (2009) identify two types of researchs: the cross-sectional and the longitudinal. The cross-sectional research is the study of a specific case within a specific time. The researchers in this type might be trying to define and study a phenomenon or to clarify how some factors are related to each other at a specific time. The quantitative approach is normally used in cross-sectional

research; however, researchers may also use qualitative methods such as case studies that are based on interviews conducted normally over a short period. (Saunders, et al., 2009)

In contrast, longitudinal research studies changes and development. By witnessing people or occasions over time, the researcher will be able to practice a measure of control over variables being studied, if they are not affected by the research process itself. (Saunders, et al., 2009)

For this research, the cross-sectional approach is the most appropriate for three main reasons:

- The research is studying how the success factors are related to each other and to the project size.
- The survey strategy is used to collect the primary data.
- The time limitation of the research.

3.3 Research Framework

Based on the idea that positivism philosophy was chosen, deductive analytical research approach would be the most appropriate for this study (Saunders, et al., 2009, p. 124). A deductive analytical approach allows the researcher to use existing literature and ideas to build up and develop the new theory, while in the inductive analytical approach the researcher develops the theory and support it with enough relevant cases. (Saunders, et al., 2009)

Moreover, the deductive analytical approach allows the researcher to collect data regarding specific research questions and framework. It will also allow the researcher to identify the number and the type of the organizations that are most appropriate for the research questions from which the data will be collected. The deductive approach also allows the researcher to use the literature to shape the data collection questions in addition to developing an initial set of categories that can relate to the research objectives. (Saunders, et al., 2009; Bryman & Bell, 2003)

By using the deductive approach, the researcher is able to gather the recent knowledge in the subject area, and develop, test and analyze the hypothesis, in order to develop the current theory. This research tries to identify a possible overall trend in relations

between construction project size and the related factors that lead to success. Therefore, a combination of quantities and qualitative methods was used, since these two approaches complete each other.

Moreover, the data collection will be mainly done by conducting a quantitative approach using a questionnaire and qualitative approach using semi-structured interviews. Hence, this research is considered a multi-method quantitative study. Quantitative approaches would provide a more valid data taking into account the scope of research. Qualitative approaches can be used also since they provide more flexibility. (Saunders, et al., 2009; Bryman & Bell, 2003)

The framework of the research starts from the literature review and extract the critical success factors, out of which a short list of factors was developed, and validated through a semi-structured interview with professionals and project manager.

Semi-structured interviews were chosen as a data collection method to study the area in depth and add knowledge to the existing success factors in the construction industry. The result of the interviews and the shortlist of CSFs were used to develop a questionnaire.

A survey method was used since it is beneficial when the research question needs structured data, which will be collected from samples of a larger population; it is also one of the most used data collection techniques. The survey technique is an effective tool when the target is a large sample, and since the questions stay the same, it is a more reliable tool for quantitative analysis. (Saunders, et al., 2009)

Despite the fact that the self-completion survey is quite similar to a structured interview, surveys, on the other hand, are not affected by the interviewer's biases. In addition, survey techniques are more convenient for the participant. Compared to semi-structured interviews, surveys are more confidential and able to reach more candidates in a short time. (Saunders, et al., 2009; Bryman & Bell, 2003)

The pilot questionnaire was conducted and modified to achieve the final questionnaire from which the data was extracted and analyzed. Finally, the conclusion was developed. The overall structure of the research is shown in the figure (5) below. More details about how the semi-structured interview and the questionnaire were developed and used will be discussed thoroughly in this chapter.

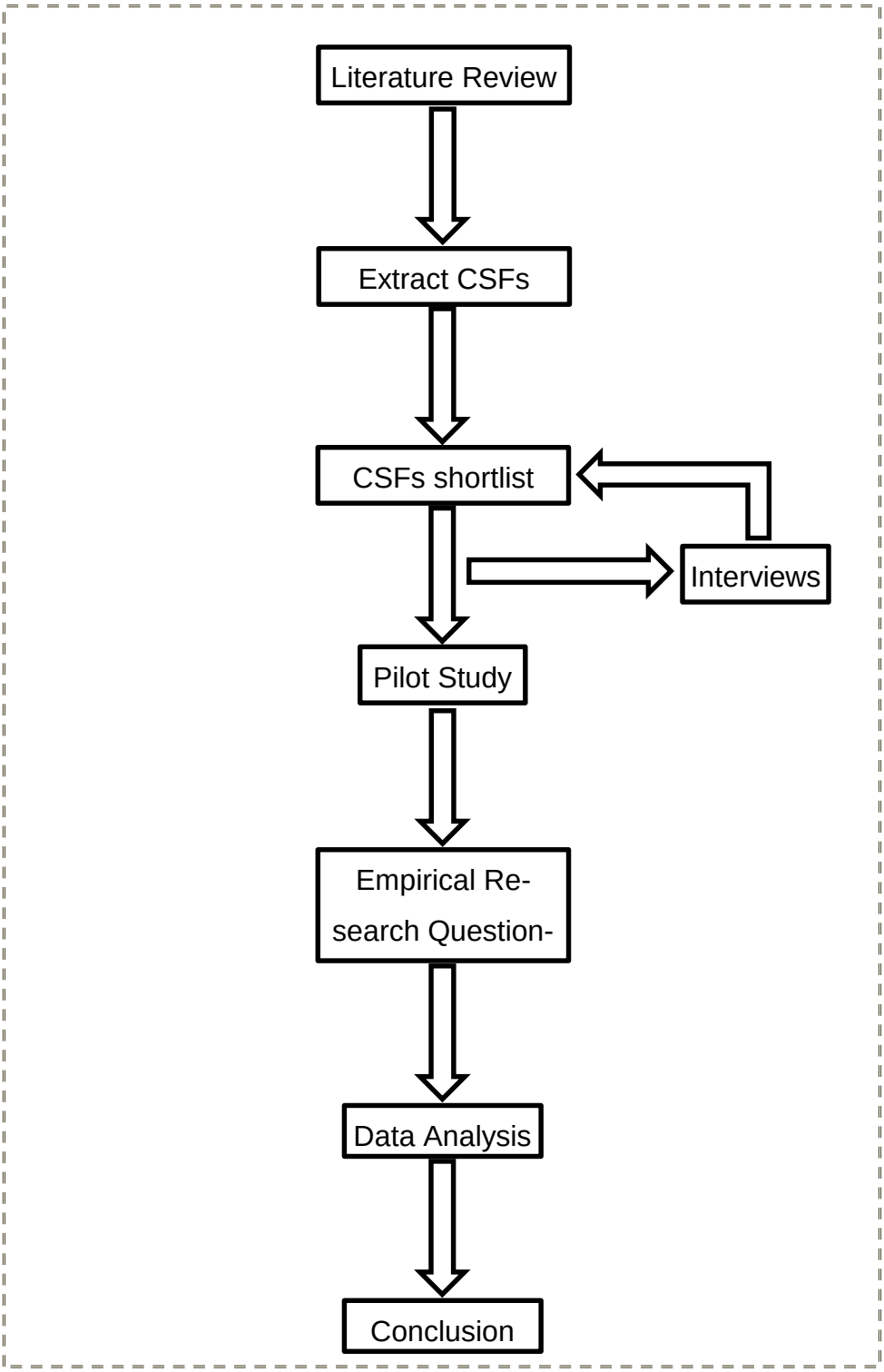

Fig. 5: Research framework

3.4 Primary and Secondary Data

Saunders, et al. (2009) believe that the secondary data are very important as they can answer the research questions partially or fully. The secondary data were collected from books, conference papers, doctoral and master thesis, periodicals, and papers from scientific repositories available from Emerald Publisher, ProQuest, ScienceDirect, and IEEE Xplore Digital Library.

The primary data were collected using a questionnaire that was built in many steps. These steps started with a critical literature review to identify the most important success factors and then using these factors to set up the general layout of the questionnaire in accordance with relevant literature and secondary data.

A semi-structured interview that was conducted with professionals and project managers before developing the questionnaire was used to verify the collected and identified data, then the supervisors of the researcher checked it and based on the supervisors' feedback the questionnaire was updated.

A pilot study test was made on the updated version of the questionnaire, this pilot study included five participants, and the questionnaire was once again updated considering the feedback from the pilot test's participants concerning the length, the ambiguity, clarity, etc. The final version of the questionnaire was then obtained (See appendix-A)

3.5 Questionnaire

The primary features of the questionnaire are related with the size of the construction projects, the main success factors in construction project generally and the relation between the size and the success factors.

Many factors point out that the survey is a suitable approach to answer the research question (Saunders, et al., 2009):

- Survey approaches are usually accompanied deductive research.
- Collection of a large amount of data from a sizeable population in a highly economical way.
- Survey strategy is considered authoritative by people in general and is both comparatively easy to explain and to understand.
- Survey increase the researcher's control of the process;

- The survey gives researchers the opportunity to save on design and increase the speed of data collection.
- Using a cross-sectional approach.

More detail of how the questionnaire was developed is provided in the coming paragraphs (see 3.7.4 Stage 4: Developing the Questionnaire).

3.6 Semi-Structured Interviews

"*Method of collecting data in which selected participants are asked questions in order to find out what they do think or feel*." (Collis & Hussey, 2003)

To search in depth and to validate the extracted success factors, a semi-structured interview was conducted. The main purpose of using semi-structured interviews in this research is to validate the obtained short list of success factors and to provide an overview of the general trend in success factors in construction projects.

Collis and Hussey (2003) believe that using semi-structured interviews is useful in the following cases:

- To discover the interviewee's thoughts and ideas about specific areas of the research.
- When 'specific aspects' of the research topic are not clear.
- When the research is related with confidential or commercially information.

Since research questions in this research are related with the identifying success factors and their correlations, managers' ideas are essential as they direct construction projects day by day and they may provide some ideas that were not covered by the literature review.

Moreover, no previous research was conducted on the relationship between project success factors in the construction industry and the size of the project, the literature was used to identify the factors to be included in the questionnaire. Nevertheless, semi-structured interviews will be used to understand the topic from the experience point of view.

In addition, management practices could be related to the knowledge of the companies; therefore, semi-structured interviews are conducted to resolve the ethical issue.

All the data that the interviewees wanted them to be confidential were not introduced in this research. The detailed design of the semi-structured interviews is showing in paragraph (3.7.3 Stage 3: Design Semi-Structured Interviews) below.

3.7 Research Procedures

The research was carried out in five stages that went in sequence as follows:

3.7.1 Stage 1: Literature Review

A wide internet-based search was conducted through doctoral thesis, periodicals, and papers from scientific digital libraries available such as Emerald Publisher (www.emeraldinsight.com), ScienceDirect (www.sciencedirect.com), and IEEE Xplore Digital Library (ww.ieeexplore.ieee.org).

In the beginning, the keyword “construction project success” was used. The results were 111 publication in the three libraries. The next keyword was “Project success factors”, which resulted in 389 publication. Finally, “Project success criteria” was used as a keyword and it resulted in 266 publications. The result of this research is showing in the table (Tab. 8) below.

The obtained results were analyzed after going through the “title” and the “abstract” of the repositories. A total number of 116 papers through the review of the title and abstract were selected for further study based on its relevance to the research topic.

	construction project success	Project success factors	Project success criteria	Selected
Emerald	45	90	68	33
ScienceDirect	63	277	191	79
IEEE Xplore	3	22	7	4

Tab. 8: Search results from different scientific repositories.

3.7.2 Stage 2: Identifying Success Factors

Since researching in management and construction success factors is usually depending on previous work and literature, many of the papers were mainly reviewing and

validating previous work. Therefore, from these 116 publications, only 19 was considered for further study. These 19 publications were chosen by not taking into account the publications that meet the following criteria.

Publications study success criteria: Many of the previous publications study the success parameters and criteria to which the project success will be measured rather than the success factors themselves. These publications were not considered since project success criteria differ from project success factors.

Publications study success in general: Some researchers study success in construction projects in general, they do not give a clear separation and definition between success factors and success criteria. These publications were not considered to avoid using success criteria as a success factor, which might lead to false conclusions.

Publications conduct literature review: The third group of researchers conducts only a critical literature review to gather and sort previous studies and publications in the field of construction project success without conducting an empirical research to identify success factors. These publications were not considered since the success factor that would be used in this research were selected based on their appearance in literature, and choosing these publications would result in repeating some factors more just because they were mentioned again in these publications.

Publications develop a method of measure: Publications that study success and come up with a method to measure success or identify success factors' weight without introducing a clear list of success factors. These publications were not taken into consideration since the approach of this research is to identify and list the success factors as a preparation step for analyzing them.

Publications without a list of factors: In general, any publication that did not give a clear list of success factors or the reason behind choosing these factors was also ignored and considered part of the abovementioned criteria by which the publications were sorted out.

As a result, out of these 116 publications, only 19 resources were considered. These 19 resources were thoroughly studied and analyzed to understand the publication itself and to list the success factors, which are identified by the publication. This resulted in

having a list of factors that relate to each publication with a short explanation of the factor and the reason for choosing it.

A table that includes the resources' name was created and different categories were chosen based on the overall knowledge of the researcher after studying the literature to simplify the next steps (Appendix B). These categories were:

- Project manager related factors.
- Project team related factors.
- Top management related factors.
- Factors related to client and stakeholders.
- Factors related to planners, consultants, and contractors.
- Factors related to schedules and plans.
- Risk factors.
- Factors related to the organization.
- Factors related to procurement, logistics, and site.
- Factors related to contracts and tendering.
- Social, cultural, and environmental factors.
- Factors related to quality.
- Factors related to time.
- Factors related to cost and finance.
- Other possible factors.

Next, success factors were inserted into the right category with the name of the factor and the marking that shows in which resources the factors were mentioned. After that, the factors that were in the same category and have the same scope were combined after double-checking the reason and the explanation of each factor to make sure that they could be combined.

The result was 188 success factors sorted out in a table that shows in which resources each factor was listed as well as how many times the factor was repeated in literature. Taking into consideration the time limitation of this research, only the 15 most repeated factors were considered in the succeeding stages. Appendix C shows the 188 success factors, the related resource, and the factor frequency count. The most repeated success factors in literature were respectively as shown in (**Error! Reference source not found.**):

3.7.3 Stage 3: Design Semi-Structured Interviews

The use of the semi-structured interviews in this research is limited to two goals.

1- Evaluate the shortlist of project success factors and identify the possibility to determine different factors that might better represent the success in 15 factors.
2- Evaluate and enhance the quality of the survey by conducting a pilot testing.

The result of these interviews would be a possible amendment for the success factors shortlist and the final corrections for the questionnaire questions and layout before launching it.

Interviewee's views and ideas about the subject are important. Therefore, the goal of the interview was to explore the area in depth rather than concentrating on asking a specific list of question. Nevertheless, a list of questions was used to cover all important and related topics.

At the beginning of the interviews, general questions were introduced to form a contact with the participants, which facilitate a smooth start of the interview. The interviews will include also information about the interviewee as well as their understanding of project success topic and its possible relation with the project size. This information would be valuable since they could not be obtained from the literature.

The main subject of the interviews is asking the interviewees about their opinion regarding the success factors shortlist and whether they think there is a better way to represent the success factors in construction project while keeping 15 as the maximum number of factors. First, the participants were asked to identify some success factors, which they had believed the most important factors for project success. Then the shortlist was shown to them to comment on it.

Regarding the second goal of the interviews, the participants were asked to provide their feedback regarding the questions, the used language, and the questionnaire layout in general. Asking for feedbacks were placed second after asking the candidates their opinion on the topic to avoid bias.

The general flow of the pre-set questions was followed. At the end of the interview, the participants were asked to fill out the questionnaire and provide their feedback to improve the questionnaire. The interview questions are the answers summary is presented in Appendix D.

The interviews were conducted with three professionals. The first is a project manager in Germany with 12 years of experience, the second is an Architect in Germany with 8 years of experience and the third is a construction manager in Qatar with 10 years of experience. The role of the candidates and their years of experience might indicate that they are able to give a clear picture of the construction industry and the success factors in specific. Due to geographical location and time limitation, the third interview was conducted by telephone. The interviews lasted between 30 and 45 minutes each.

A summary of the interview was sent to the candidates within one week after conducting the interview and their approval of the summery was obtained.

All the interviewees accepted taking notes of the interview, however, they were informed that the data would be kept confidential and will be used for study purposes only.

3.7.4 Stage 4: Developing the Questionnaire

The result of the previous stage is the table (Tab. 10) that shows the 15 most frequent construction success factors in literature. These factors were the core base for developing the questionnaire, and out of these factors, the first outline was developed.

A pilot study was conducted as discussed in paragraph (3.7.3 Stage 3: Design Semi-Structured Interviews) and by combining the feedback from the pilot study with the supervisors' comments, the final questionnaire was obtained (Appendix A).

In the final questionnaire, the first page consists of the *Covering Letter* which explained the focus and the purpose of the questionnaire and the institution in which the thesis was carried out. The cover letter also stated that the provided information would be treated in confidence. It also included the use of the given data, the expected time to do the questionnaire and encouraging the participants to complete it, leave comments where they feel appropriate, and contact the researcher when they have any related question. (Saunders, et al., 2009)

S.N.	SUCCESS FACTOR
1	Project manager experimente & leadership
2	Top management support
3	Project manager commitment to project goals
4	Project team motivation/commitment
5	Communication among all project participants
6	Appropriate organizational structure
7	Availability of resources/materials etc.
8	Social/ environment effects
9	Project manager technical capabilities
10	Project team experience in similar projects
11	Risk management / Change management
12	Safety, health and environmental program
13	Schedule / Cost / Quality Control
14	Client's involvement & monitoring
15	Scope clarity

Tab. 9: Success factors in order of importance in literature - 1

Questions 1 and 2: The first two questions were “Category questions”, The participants were asked to identify their educational background as well as their years of experience in the construction industry. These two questions were intended to collect some attributes related to the sample, therefore the “Category questions” type was used and the participants were not able to choose more than one answer. (Saunders, et al., 2009)

Questions 3: Next, participants were asked to specify the size of the projects in which they have participated. The question propose a list of choices from which the participants can choose more than one answer. These choices represent the different sizes of the project. This type of questions is a “List question” and it is beneficial to make the respondents consider all sizes. (Saunders, et al., 2009)

Questions 4: The 15 success factors, which were obtained from the previous stage, were presented to the questionnaire participants in the fourth question. The design of this question lays under “Rating questions” type, and it follows Likert-style rating scale in which the respondents were asked to choose if they think a factor is “not important”, “medium important”, and “very important” for the success of the construction project. (Saunders, et al., 2009; Bryman & Bell, 2003). This question intended to determine whether the general importance of the success factors to validate them. During the statistical analysis the following coding will be used:

Not important = 1

Medium importance = 2

Very important = 3

Question 5 to 7: The last three questions were to identify the five most important factors for small, medium, and large projects respectively. Again, the “List questions” type was used to allow the participants to choose five factors per question. This will facilitate two objectives together. First, it will identify the important factors per project size. Second, it will give the possibility to compare the factors in different size and, consequently, find any possible interrelation between all these factors together.

Listing only 15 factors and choosing five out of them was based on three reasons. First is the time limitation of the research, second is to increase the response probability, and third to have answers that are more reliable since choosing five factors out of 15 can be more efficient than choosing from 30 or 40 factors.

The participants were advised to consider time, cost, quality, and client’s satisfaction the success criteria based on which the success factors to be considered. Choosing these success criteria is explained in paragraph (3.4 Choosing Success Criteria).

3.7.5 Stage 5: Analyzing and Concluding

The result from the survey questionnaire was gathered and analyzed. In the end, the conclusion was derived from this analysis. Analyzing the questionnaire’s results and the conclusion are thoroughly discussed in sections four and five of this research.

3.8 The Population and Decided Sample

Studying a sample of a population is an effective tool when it is accurately used without biases. However, sampling should be adequately precise to represent the features of the population as much as possible. (Saunders, et al., 2009). In this research, this was taken into consideration and the sample was chosen from different locations, and different firms of different sizes.

The population of the research consists mainly of project managers who have a wide experience in construction projects and can identify the most relevant factors that lead to the success of the project. Construction managers and contracts managers can also provide an important information in regards to their type of experience. The population also include other professionals who have worked in the construction industry and able to identify the factors that can contribute to success in the projects.

Since it is impractical to survey the entire population as it is extremely wide, a sample size within this population was selected which consequently can be achieved within the deadline of this research. The sampling frame from which the sample can be selected includes the total population, and the *simple random* sampling techniques were used (Saunders, et al., 2009). The questionnaire was sent to 270 professional in the construction industry. The questionnaire was built on an internet platform, and the link was sent via E-mail to an aforementioned number of professionals, results were collected during three weeks to give the respondents adequate time to participate. Two follow up E-mails were sent to enhance respondent rate.

Out of 270 professional who received the survey, 86 responses were received while 27 were not reachable and the rest 157 professional did not take part in the survey either because of busyness, or simply because they did not want to, out of 86 responses, 26 were ineligible since they were not complete and not fitting to the research objectives. In the end, 60 legible responds were received which is an acceptable sample size for many researchers. "*Statisticians have found that for many population distributions, when the sample size is at least 30, the sampling distribution of the mean is approximately normal."* (Berenson, et al., 2012)

Therefor the total response rate and the active response rate can be calculated as follows (Saunders, et al., 2009):

$$Total\ response\ rate\ = \frac{total\ number\ of\ responses}{total\ number\ in\ sample - ineligible}$$

$$Total\ response\ rate\ = \frac{86}{270-26} = 35.24\ \%$$

$$Active\ response\ rate\ = \frac{total\ number\ of\ responses}{total\ number\ in\ sample - (ineligible + unreachable)}$$

$$Active\ response\ rate\ = \frac{86}{270-(26+27)} = 39.63\ \%$$

3.9 The pilot study

A pilot study was launched to refine the questionnaire by checking the content, the coherence, the whole structure and the information provided in the questionnaire. In addition, the pilot test will enable the researcher to assess the questions' validity. (Saunders, et al., 2009)

During the pilot test, five sets of the questionnaire were given to professionals from the aforementioned sample, and they were asked to answer the questions and to give their feedback regarding (Saunders, et al., 2009):

- How long the questionnaire took to complete.
- The clarity of the instructions.
- Which, if any, questions were unclear or ambiguous.
- Which, if any, questions the respondent felt uneasy about answering.
- Whether in their opinion there were any major topic omissions.
- Whether the layout was clear and attractive.
- Any other comments.

The final version was then developed according to the professionals' comments and feedback.

3.10 Delivering and Collecting the Questionnaire

The sample was contacted by e-mail. E-mail for professionals in the construction industry was collected from contacts working in the field; the choice of the professionals was random after making sure that the respondent has experience in the field, which make it more probable that the response is reliable.

In the beginning, the pilot study was sent to five professionals during two weeks' time. These respondents were then excluded from the original sample.

The questionnaire was delivered to the rest of the sample during the next week with a covering email explaining the questionnaire and requesting the participant to take part in it. A follow-up email to incite responding was sent a week after. In the fourth week, another follow-up email was sent to the professionals who did not participate and in the fifth week, the result was collected.

3.11 Choosing Success Criteria

The success criteria that are adapted in a project determine the project success factors to be considered. Moreover, the success factors that a contractor considers important are different from those, which the client or the end users consider important. To have a unified view of the factors and to avoid confusion, the participants were asked to evaluate all factors based on the most common success criteria, which depends on time, cost, quality, and user satisfaction. This decision is based on a study conducted by Khosravi and Afshari in 2011. They introduced a model to calculate and evaluate construction project success. The model considers four project success parameters that are related to time, cost, quality, and client's satisfaction. These parameters were developed by conducting two-rounds questionnaire, in which experts in the field of construction projects participated. From the questionnaire, the top four scored factors were chosen to be used in the model. Figure (6) shows the adopted success criteria in the questionnaire.

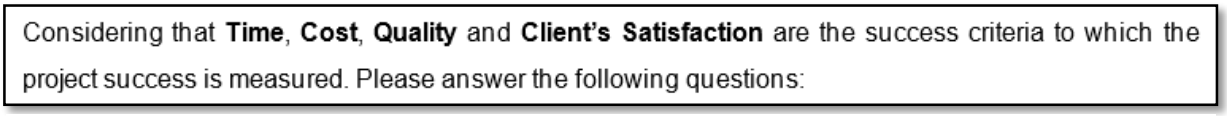

Fig. 6: The adopted success criteria in questionnaire

"The conventional measures or the so-called iron triangle of time, cost, and quality has been the dominating performance indicator in construction projects" (Toor & Ogunlana, 2010).

3.12 Assessing Validity of the Questionnaire

The validity was verified by several means. Reviewing the literature from books, scientific journals, conference papers, reports and so forth enhance the knowledge about success factors and project size in general. Factors that were extracted from the literature review was also verified through interviews with professionals before developing the questionnaire. Therefore, the validity was proved through different means.

3.12.1 Internal Validity

The relation between the project success factors and the construction project size is directly stated in the questionnaire, and the result is reflecting how these factors and the project size are correlated. Therefore, the questionnaire internal validity is verified by the ability to reflect the relationship between the project sizes and the project success factors.

3.12.2 Content Validity

The questionnaire was developed in stages through which the content was in progressive elaboration. As the final draft was ready, it was sent to the researcher's supervisors who double check and comment on the content which was again developed accordingly. The structure and the sentences within the questionnaire were carefully chosen to be clear and exact at the same time and to avoid misunderstanding as much as possible.

3.12.3 Predictive Validity

The questionnaire states factors that are categorized based on the size and these factors are also combined with importance ranking. Therefore, the questionnaire can accurately predict the relationship between the success factors and project size. Having only five success factors related for each size might not reflect the whole picture of the relation between these variables, however, due to the timeframe for executing the research, five factors were adopted in this research with suggesting further and wider research in the same research direction.

3.13 Research Methodology Limitations

Research strategy: the self-completion survey was chosen to be the main research strategy. Since understanding the questions can vary based on experience and educational background, this might result in findings that are not fully accurate. (Bryman & Bell, 2003)

Using the survey to conduct the research did not give the researcher the possibility to reach the respondents more than once. Hence, searching, clarifying and questioning some details in depth was not possible, which is another limitation of this research.

Another limitation that is associated with choosing the survey as a research method is the response rate. Despite the fact that, the response rate for this research (35.24%) is reasonable, the opinions of the rest of the sample (64.76%) were not possible to be collected. (Saunders, et al., 2009)

Quantitative methodology in research strategy did not give the researcher a chance to search the topic as deep as it could be possible in a qualitative research technique (Saunders, et al., 2009). Which, consequently, limit the data analysis.

4. Analyzing the Data

4.1 Introduction

In this section, the data that was obtained from the literature and the questionnaire will be analyzed. This chapter will provide in addition to the representations of the survey results, systematical analysis, discussion, and explanation concerning the results based on the obtained quantitative data.

The first part of this chapter will introduce and discuss the obtained success factors from the literature. This would be combined with a general illustration of these factors and their scope in the construction projects.

Analyzing the sample's feature will be the second concern of this chapter, where the characteristics of the participants concerning their experience and education will be illustrated. Which might explain some trends in the construction market.

After that, the results of the survey regarding the success factors' importance and the relation between success factors and project size will be presented graphically and discussed. This would provide an overview of the interrelation between these factors and the project size. Additionally, a comparison between the success factors related to size and the success factors in general, will be drawn, which would introduce the next part of this chapter.

At the end of this chapter, different correlation coefficients would be presented. These coefficients would illustrate the interrelation between different aspects such as the project success factors in general, the project success factors for small construction projects, the project size with each one of the success factors and so forth.

4.2 List of Success Factors

Based on the literature analyzes that was described in Section 3 (see: 3.7.1 Stage 1: Literature Review), the15 most important factors for construction project success in the literature was obtained as shown in Table (Tab. 10). The literature shows that the most important success factor is related to the project's manager experience and leadership, which highlights the important role of the project manager in leading the project to suc-

cess. This is followed by Top management support, which might indicate that the success started from the company itself, and top management should commit to the project to achieve success. In third and fourth place are the commitment of the project manager to project goals and the project team motivation and commitment respectively, this emphasizes the idea that involvement and loyalty to the project have a great deal in achieving success. Moreover, having a factor related to project team among the top most frequent success factors might indicate that the project would success from teamwork rather than from individual endeavors.

The fifth factor is communication among all project participants. This reflects the current growing importance of communication, therefore, having active communication channels in the project could enhance the likelihood of success. The sixth and seventh success factors are also related to the performing company (Appropriate organizational structure, Availability of resources and materials).

Out of these seven most important factors, six relate directly with the performing company, which shows that success can be internally enhanced; it also shows that performing company should probably focus on the internal processes and structure in order to obtain success.

Social and environmental effects were repeatedly mentioned in literature. This reflects the influence that the social aspects have on the project along with the influence of the environment. The ninth and tenth factors are the technical experience of the project manager and the project team's experience with similar projects respectively. This, therefore, might be the effect of experience in projects. Having these factors among the most repeated success factors indicate that having management skills might not be enough for the project manager's competency.

Risk and change management is crucial for the success of the project and it was ranked in the eleventh place. In addition, having safety, health, and environmental programs, additionally to having means of control over cost, schedule and quality are the twelfth and thirteenth factors respectively. This might indicate the importance of control and preparedness in achieving project success.

Client's involvement is also very important for success and it is the fourteenth factor while having a clear project scope is the fifteenth factor. This might indicate that ambiguity in projects is a big obstacle facing project success; therefore, client's involvement

and having a clear scope, which decreases ambiguity, are in such importance of the success of the project.

S.N.	SUCCESS FACTOR
1	Project manager experimente & leadership
2	Top management support
3	Project manager commitment to project goals
4	Project team motivation/commitment
5	Communication among all project participants
6	Appropriate organizational structure
7	Availability of resources/materials etc.
8	Social/ environment effects
9	Project manager technical capabilities
10	Project team experience in similar projects
11	Risk management / Change management
12	Safety, health and environmental program
13	Schedule / Cost / Quality Control
14	Client's involvement & monitoring
15	Scope clarity

Tab. 10: Success factors in order of importance in literature - 2

4.3 Analyzing Sample Features

The following paragraphs will describe the results obtained from the survey and related to the features of the sample, which are further divided into personal features and experience features. Moreover, these results will be analyzed and thoroughly discussed.

4.3.1 Personal Features

Educational level: the first question of the questionnaire asked the participant about his/her level of education, and the result of the survey was as showing in figure (7).

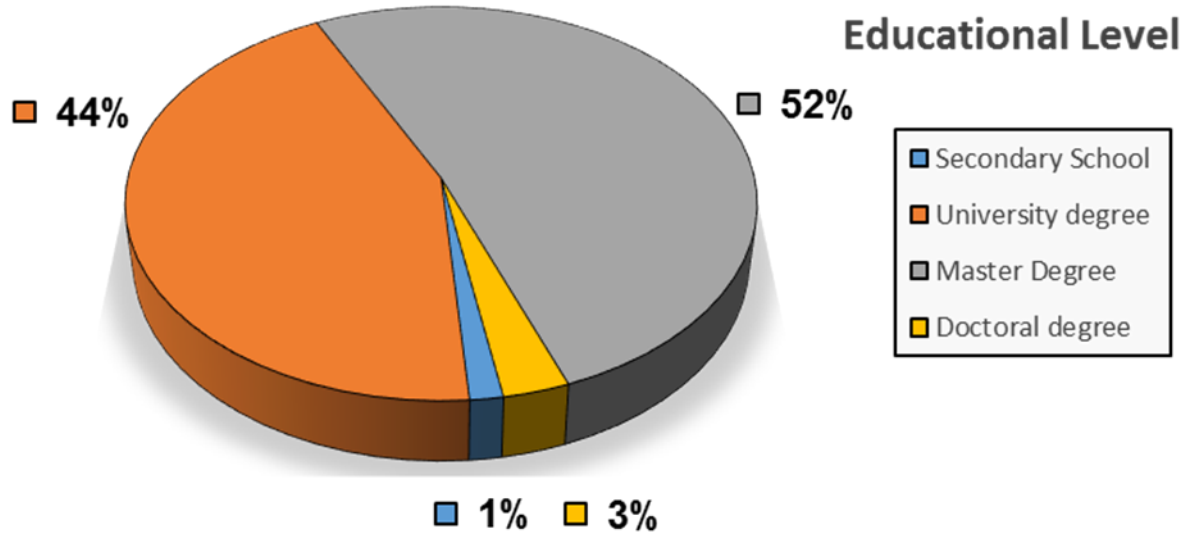

Fig. 7: Participants' educational level

Figure (7) shows that 52% of the professionals who are involved in construction projects management are holding a master's degree. Moreover, the second proportion is professionals with a university degree (44%), in addition to 3% for the doctoral degree. This reflects the high level of education in management in the construction sector. This might also reflect the high reliability of the participants, which increase the credibility of this research and its results.

On the other hand, it is possible that this figure reflects the current trend in the construction industry, which Al-Zahrani (2013) had referred to as “increasing complexity” and “the involvement a multitude of stakeholders”, which result in requiring competitive and highly educated professionals.

4.3.2 Experience Features

Years of experience: regarding years of experience, the questionnaire results show that 35% is having experience less than five years and 28% between five and ten years and the rest 37% are having more than ten years’ experience as shown in figure (8). The almost equal distribution of experience over the sample might reflect the continuity of demand on construction management’s professionals. However, the highest proportion is dedicated to experts with more than ten years of experience, which support the reliability of the answers, in addition, to depicting the high need for experience in the construction industry (Gudienėa , et al., 2013).

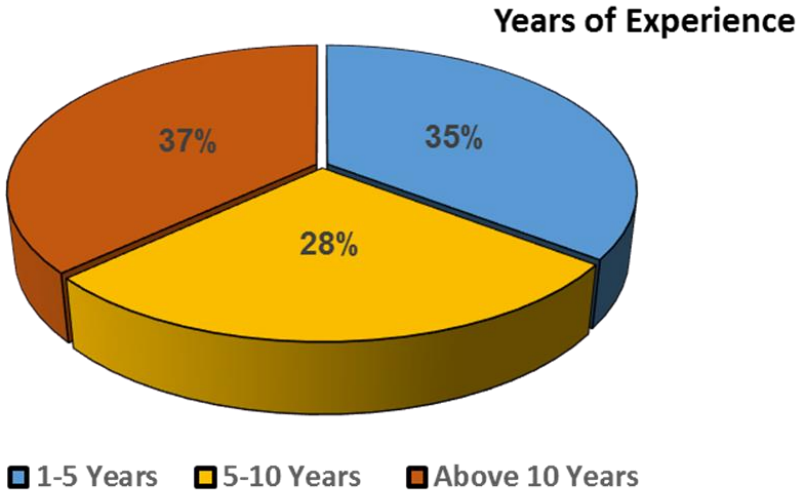

Fig. 8: Participants‘ years of experience

Size of projects: in the questionnaire, the sizes of the project were divided based on the division adopted by Josey & England, 2009:

- Small size projects: less than $5 Million.
- Medium size projects: from $5 Million to $500 Million.
- Large size projects: more than $500 Million.

In the survey, the participants were asked to choose the projects’ sizes in which they had work with the possibility to choose more than one size depending on which sizes

the participant has worked. As a result, 43% of the professionals have worked in large projects, where only 34% have worked in medium size projects and 23% have worked in small projects. This could be an indication of the trend in construction projects which are becoming more complex and larger over time (Al-Zahrani, 2013). The percentage of professionals who have worked in each size is shown in figure (9).

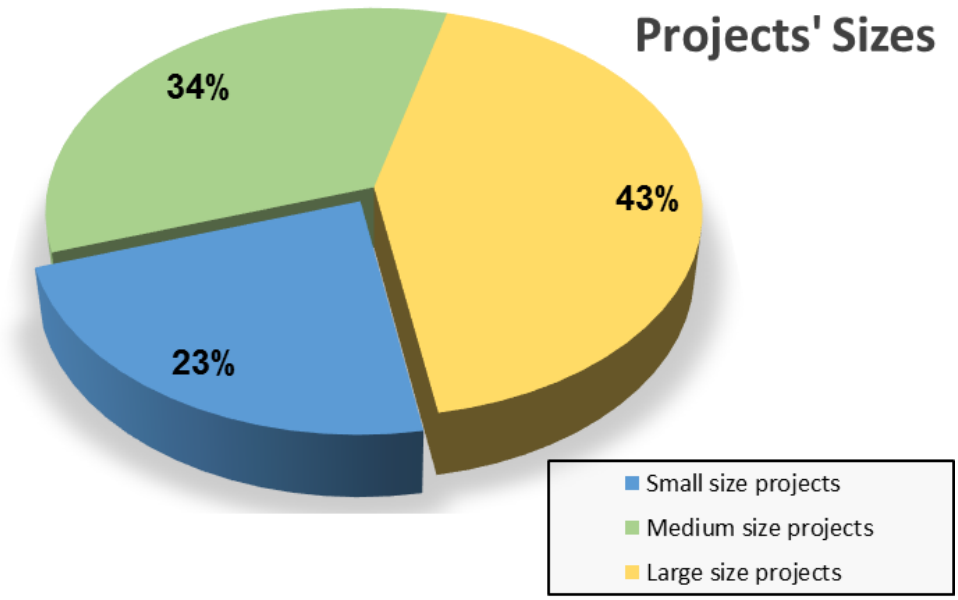

Fig. 9: Proportion of professionals who have worked in each project size

4.4 Analyzing Success Factors for Different Sizes

4.4.1 Success Factors Validation Discussion

To validate the 15 chosen success factors, the participants were asked to evaluate these factors whether they are: not important, medium important or very important for the project success, the results of this evaluation were as shown in the table (Tab. 11: Question 4 results.).

Success Factor	Not Importan	Medium Importance	Very Important	Sum
Top management support	5	20	35	60
Project manager experience and leadership	1	11	48	60
Project manager commitment to project goals	1	14	45	60
Project manager Technical capabilities	6	37	17	60
Project team motivation/commitment	2	3	55	60
Project team experience in similar projects	3	37	20	60
Appropriate organizational structure	0	20	40	60
Communication among all project participants	4	8	48	60
Availability of resources/materials etc.	4	16	39	59
Social/Environment effects	9	36	15	60
Risk management/Change management	3	29	28	60
Safety/health/Environmental program	8	28	24	60
Schedule/Cost/Quality control	2	13	45	60
Client's involvement and monitoring	7	30	23	60
Clear Definition of scope	1	15	44	60

Tab. 11: Question 4 results.

By applying the coding system describe earlier for this question (see 3.7.4 Stage 4: Developing the Questionnaire) the results from this question will be as shown in table (Tab. 12: The mean, standard deviation, and the variation coefficient for each success factor**.**) where the variation coefficient is measuring the spread of the data in the relative variable sample. (Saunders, et al., 2009)

Success Factor	Min. Value	Max. Value	Mean	Std. Deviation	variation coefficient
Top management support	1	3	2.50	0.65	26.04
Project manager experience and leadership	1	3	2.78	0.45	16.33
Project manager commitment to project goals	1	3	2.73	0.48	17.65
Project manager Technical capabilities	1	3	2.18	0.60	27.31
Project team motivation/commitment	1	3	2.85	0.48	16.88
Project team experience in similar projects	1	3	2.30	0.53	23.06
Appropriate organizational structure	1	3	2.68	0.47	17.48
Communication among all project participants	1	3	2.75	0.54	19.66
Availability of resources/materials etc.	1	3	2.53	0.72	28.58
Social/Environment effects	1	3	2.12	0.61	28.97
Risk management/Change management	1	3	2.40	0.56	23.27
Safety/health/Environmental program	1	3	2.27	0.69	30.25
Schedule/Cost/Quality control	1	3	2.73	0.52	18.89
Client's involvement and monitoring	1	3	2.28	0.67	29.18
Clear Definition of scope	1	3	2.72	0.49	18.05

Tab. 12: The mean, standard deviation, and the variation coefficient for each success factor.

The survey confirms the importance of many success factors from literature. Project team motivation and commitment is a very important factor for 92% of the participant, it has a mean of 2.85 with the second lowest variation coefficient of 16.33 (The percentage for each factor is showing in Fig. 10: Success factors evaluation), this makes project team motivation and commitment the most important factor. In addition, 80% think project manager experience and leadership, and communication among all project participants are very important to the success of the project, the mean of these two factors are 2.78 and 2.75 respectively meaning that project manager experience and leadership, and communication among all project participants are the third and fourth important factors.

Between 65% and 75%, with means range from 2.53 to 2.73, believe that project manager commitment to project goals, appropriate organizational structure, availability of resources and materials, clear definition of scope, control of schedule, cost and quality are very important to achieve success. All these factors have almost the same variation coefficient that is around 18 except availability of resources and materials, which has

a variation coefficient of 28, which means that the opinions of the participants regarding this factor vary more than for the others.

Project manager technical capabilities, project team experience in similar projects, social and environment affect have means of 2.18, 2.3, and 2.12 respectively. Moreover, these factors are medium important for 60% to 62% of the participants, where only 25% to 33% believe that these factors are “very important”.

In addition, risk and change management, client’s involvement and monitoring, and safety, health and environmental program are very important for 47% to 50% and almost the same proportion (38% to 47%) believe these factors have medium importance.

The variation coefficient in the table (Tab. 12) shows that the participants have different opinions regarding safety, health and environment program factor which have the highest variation coefficient (30.25). They also have varied opinions concerning client’s involvement and monitoring, social and environmental effects, availability of resources and materials, and project manager technical capabilities. On the other hand, the project team motivation and commitment, and the project manager experience and leadership have the lowest variation among the participants. In general, from watching the mean value we can notice that the factors might be divided into five groups as shown in the table (Tab. 13: Success factors groups based on the mean value).

2.75 - 2.85	Project manager experience and leadership
	Project team motivation/commitment
2.65 - 2.75	Appropriate organizational structure
	Clear Definition of scope
	Project manager commitment to project goals
	Schedule/Cost/Quality control
	Communication among all project participants
2.40 - 2.55	Risk management/Change management
	Top management support
	Availability of resources/materials etc.
2.25 - 2.30	Safety/health/Environmental program
	Client’s involvement and monitoring
	Project team experience in similar projects
2.10 - 2.20	Social/Environment effects
	Project manager Technical capabilities

Tab. 13: Success factors groups based on the mean value

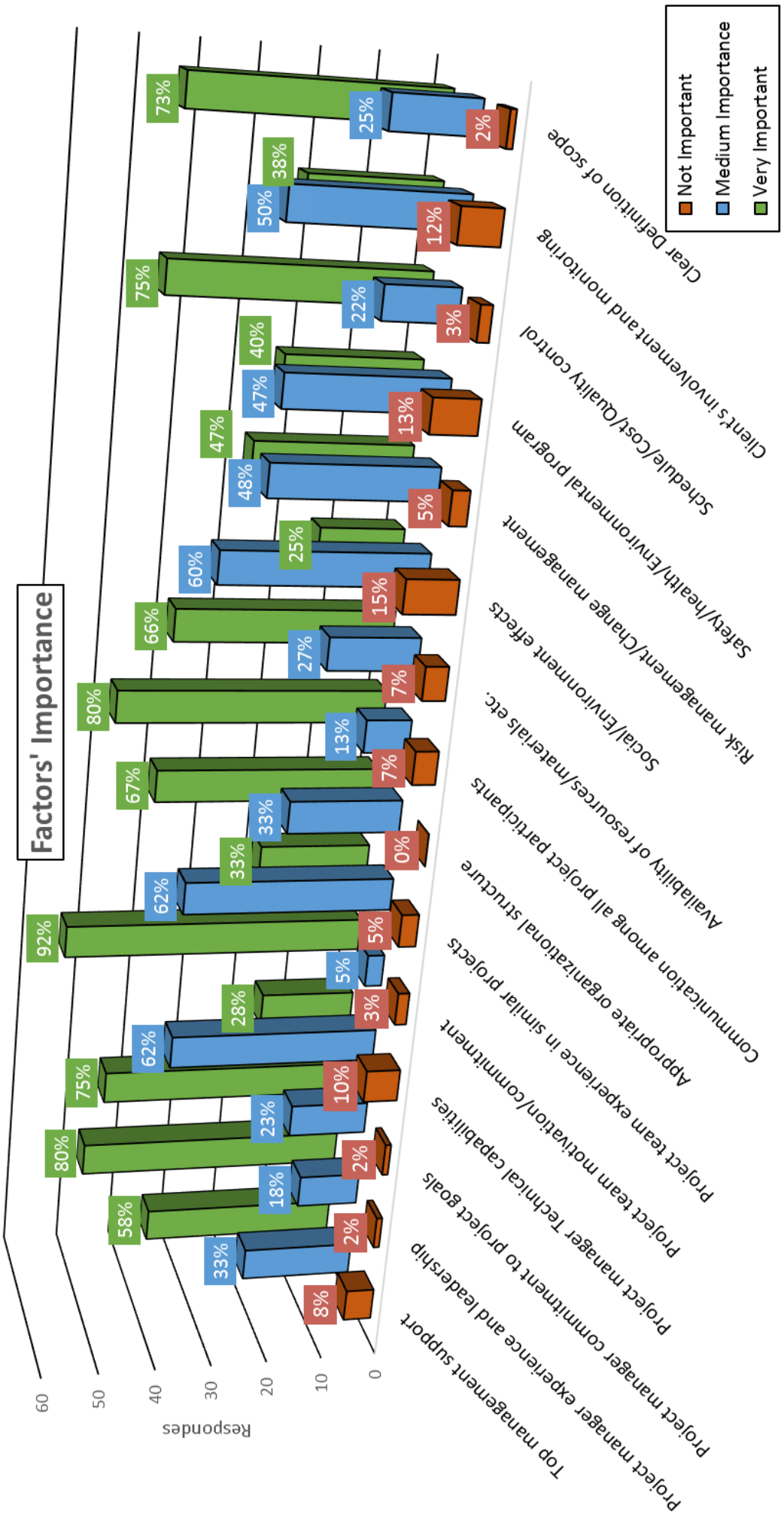

Fig. 10: Success factors evaluation

4.4.2 Small Project

The fifth question asked the participant based on their experience to choose the five most important factors related to small projects. The results of this question are shown in figure (Fig. 11)

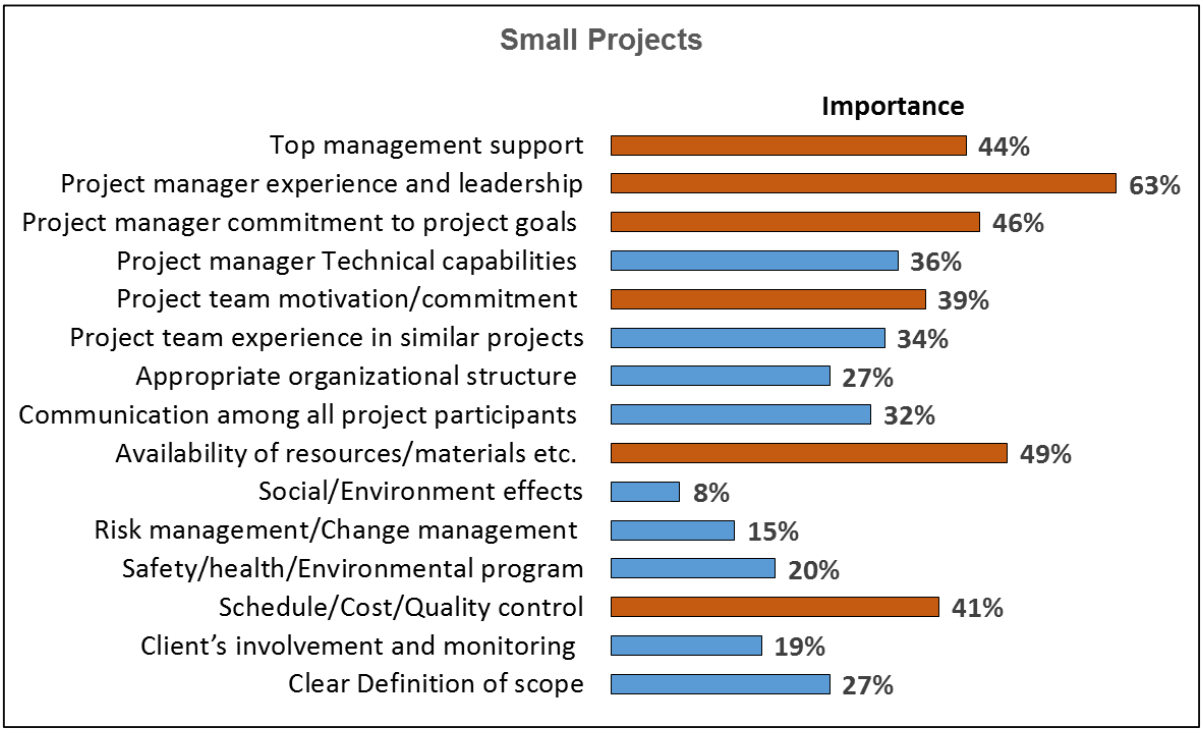

Fig. 11: Importance of each success factor for small projects

Project manager's experience and leadership is the most important factor and it was chosen by 63% of the participants. This might reflect the huge impact of project managers in small projects.

The second important factor is the availability of resources and materials by 49%, which might be due to the schedule shortness and tightness in small projects where any delay in resources and materials can affect the outcome of the project. The other important factors are top management support and project manager commitment to project goals with 44% and 46%. Schedule, cost, and quality control and project team motivation and commitment are in the fourth and fifth place with 41% and 39%.

The results show that the social and environmental effect, as well as the risk and change management, do not have a great impact on reaching success.

4.4.3 Medium Project

Based on the questionnaire, the five most important factors that lead to success in medium construction projects are shown in figure (12). Similar to small projects, the project manager's experience and leadership is the most important factor and it was chosen by 63% of the participants. This might reflect the huge impact of project managers in medium and small projects. The second important factor is top management support and project manager commitment to project goals with 53% and 48% respectively.

The other important factors are project team motivation and commitment, and availability of resources and materials with 39% each, which might be due to the schedule shortness and tightness in medium projects where any delay in resources and materials can affect the outcome of the project, and where the project team plays a significant role in achieving the project goals. However, the results of medium projects are very close to the small project's result.

The results show that the social and environmental effect, as well as the client's involvement, do not have a great impact on reaching success. Nevertheless, the results show that there is no dominant factor.

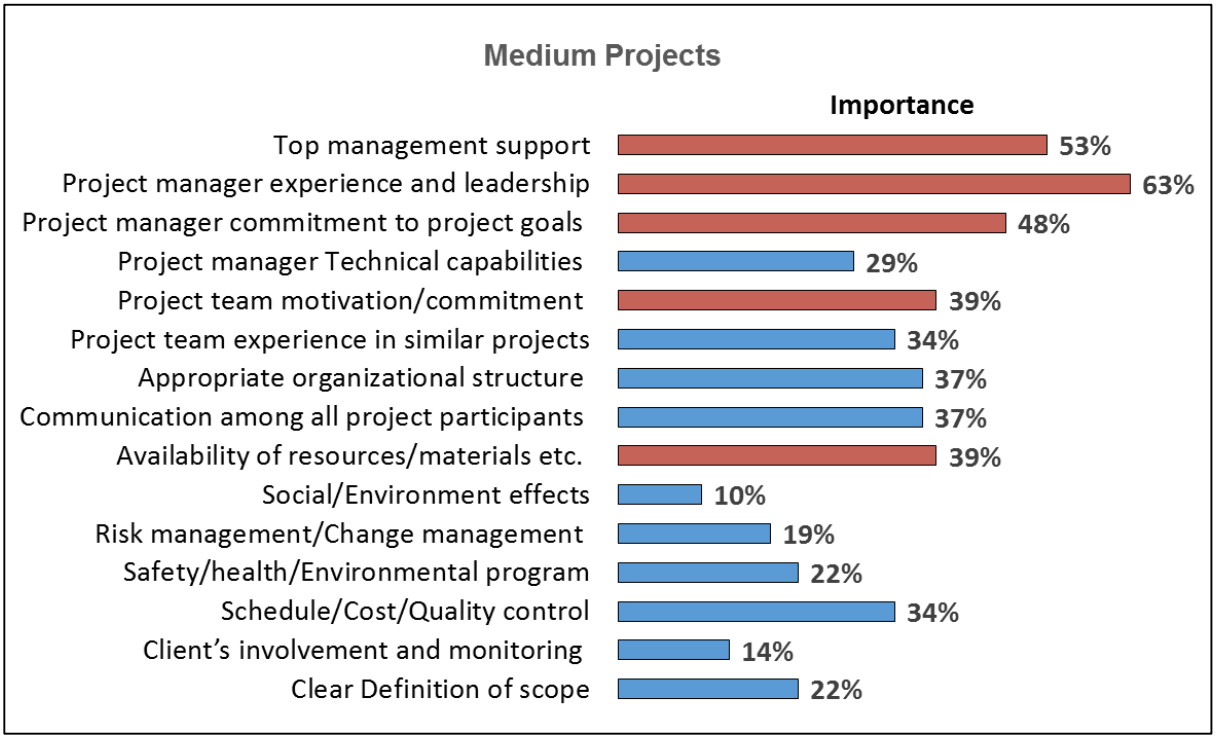

Fig. 12: Importance of each success factor for medium projects

4.4.4 Large Project

In the seventh question, the participants were asked to choose the five most important factors that lead to large projects and the results were as shown in figure (13). Parallel to small and medium projects, Project manager's experience, and leadership is the most important factor and it was chosen by 69% of the participants, followed by top management support similarly to medium projects with 67%. Project manager commitment to project goals is third with 43%.

The other important factors are appropriate organizational structure and control of schedule, cost, and quality of 41% and 38% respectively. These factors (appropriate organizational structure, control of schedule, cost, and quality) appeared only in large projects, which might be an indication that a good structure in the organization can be crucial for the success of large projects. This might also reflect the importance of control in large projects.

Despite not having dominant factors, still top management support and project manager's experience and leadership seem to be unique from the other factors. The results show that the social and environmental effect, as well as the client's involvement, do not have a great impact on reaching success in large projects.

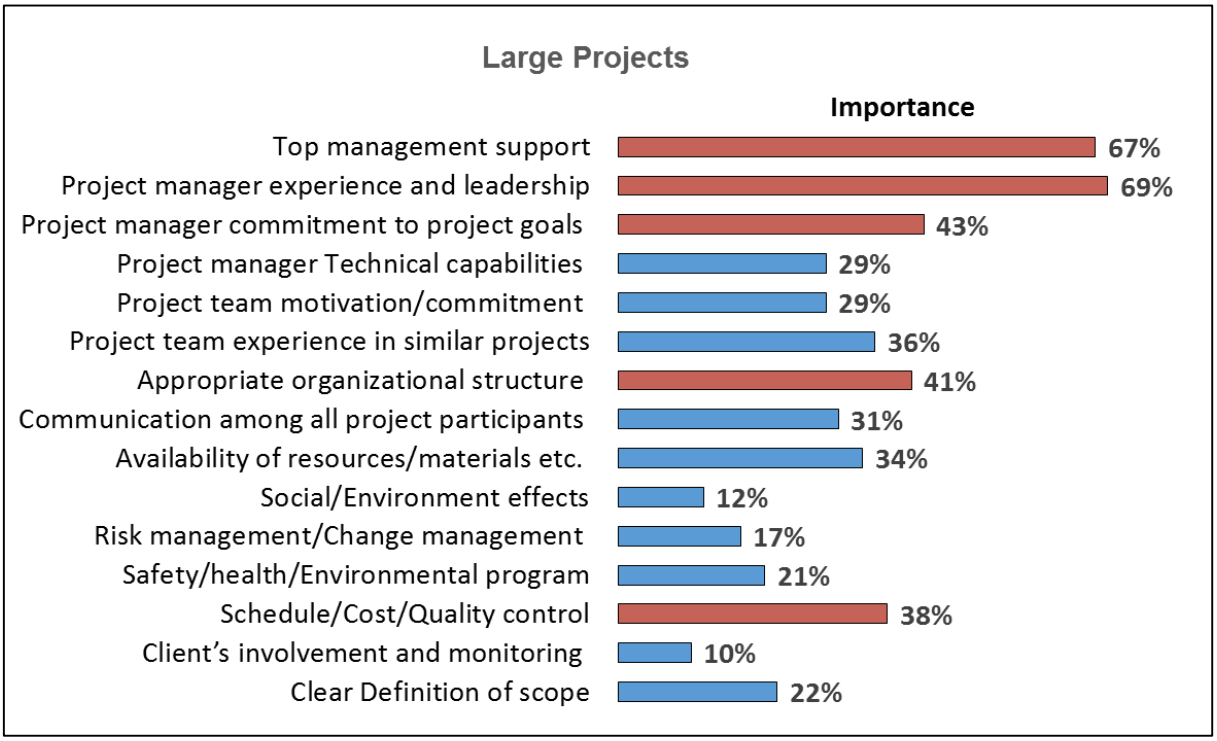

Fig. 13: Importance of each success factor for large projects

4.4.5 Comparing Factors for Different Sizes

Analyzing the results of success factors in small, medium, and large projects shows that Project manager's experience and leadership, top management support, and project manager commitment to project goals are the most important factors in all three sizes. However, for small project, availability of materials is more important than project manager commitment to project goals.

In addition, availability of resources and materials is in the five most important factors for small and medium projects. On the other hand, having control over schedule, cost and quality is between the five most important factors for small and large projects. Table (Tab. 14) shows the five most important factors for each size.

Small	Medium	Large
Top management support	Top management support	Top management support
Project manager experience and leadership	Project manager experience and leadership	Project manager experience and leadership
Project manager commitment to project goals	Project manager commitment to project goals	Project manager commitment to project goals
Availability of resources/materials etc.	Availability of resources/materials etc.	Appropriate organizational structure
Schedule/Cost/Quality control	Project team motivation/commitment	Schedule/Cost/Quality control

Tab. 14: The five most important success factor for each project size.

Moreover, figure (14) shows the results when the factors from different sizes were combined together. As showing in the figure, the success factors tend to follow almost the same trend in all sizes until it reaches the highlighted area that includes three factors: Top management support, availability of resources, and appropriate organizational structure where the influence of these factors vary based on the project size.

Nevertheless, availability of resources and top management support have a relatively high variation coefficient, that are 28.58 and 26.04 respectively, and the results deviate widely from the mean. On the other hand, appropriate organization structure has a very low variation coefficient (17.48), which means that the results spread close to the mean. Therefore, it is possible to assume that the participants share the same opinion about appropriate organization structure; therefore, its representation is more liable, contrary to the other two factors.

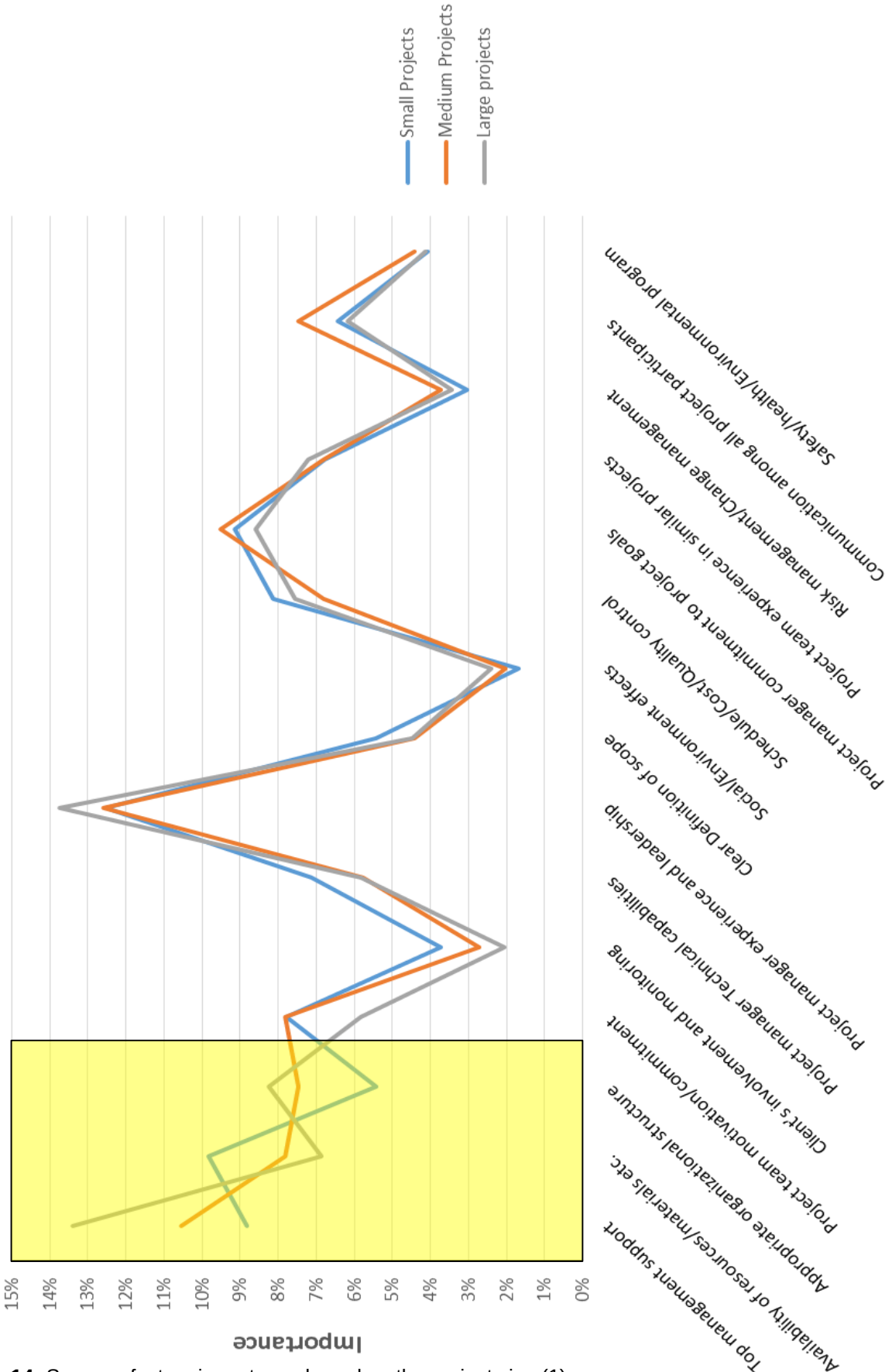

Fig. 14: Success factors importance based on the project size (1)

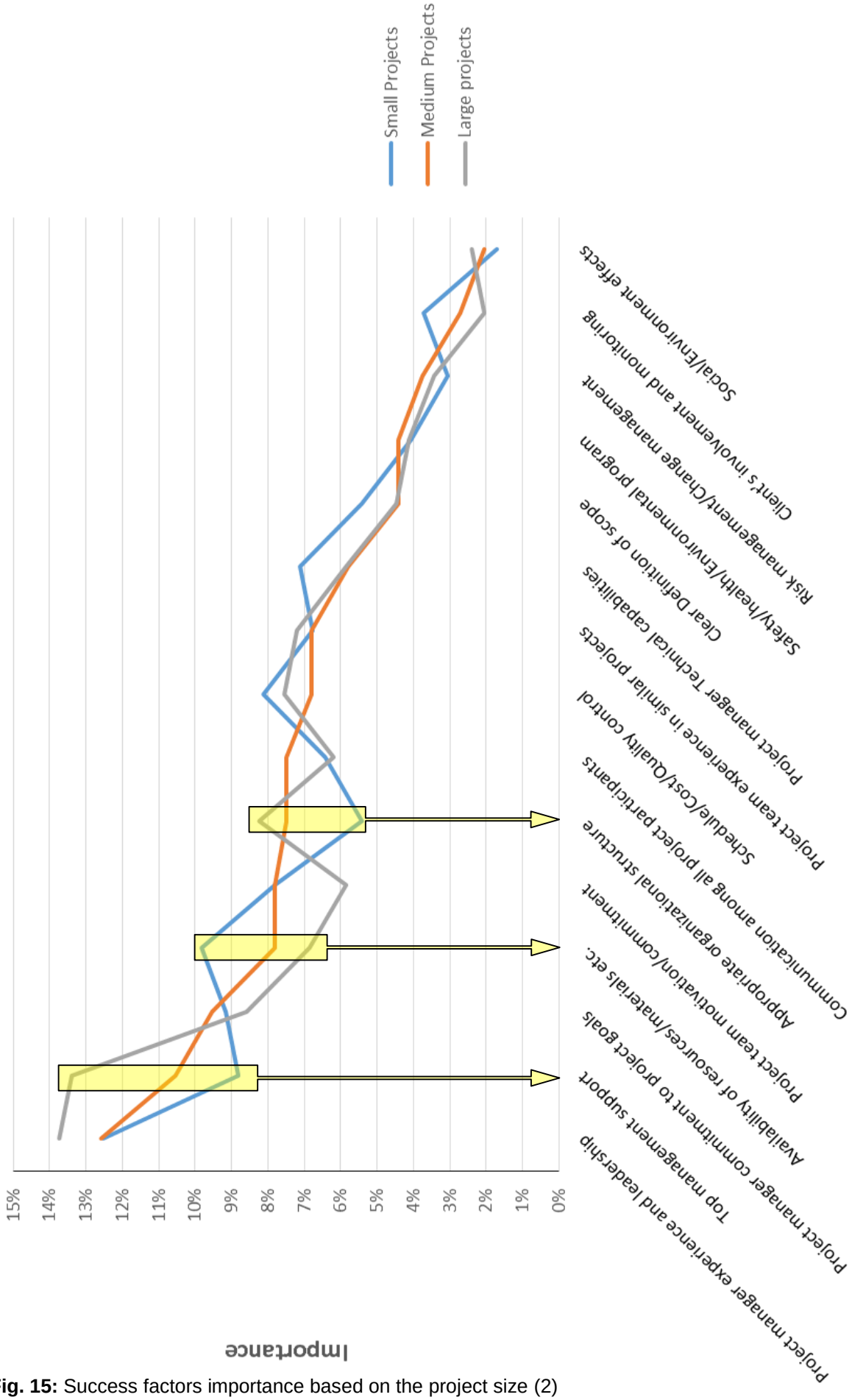

Fig. 15: Success factors importance based on the project size (2)

Top management support is crucial for a large project and is the most important factor, whereas, in small projects, this support does not have the same effect in success. This might be due to the complexity and challenging characteristics of the large project. Similarly, having an appropriate organization structure is very important to large projects whereas for a small project it is relatively not. This can be related to the same reason of the characteristics that large projects have.

Having available material and resources is more important for small projects than for large projects. This might be resulted from short durations of small projects compared to large ones since a few days delay in materials would probably have a direct impact on the project's cost and handing-over date, but in the larger project, this delay could be overcome throughout the project long duration. Figure (15) also shows the results when the factors from different sizes were combined together but they were arranged in declining order of factors' importance for medium projects.

When the factors' importance based on the project size were arranged together with the mean of importance for each factor which was obtained from the fourth question in the survey when the participants were asked to identify - regardless the size - if a factor is "not important", "medium importance", or "very important", the results were as shown in figure (Fig. 16). The graph shows clearly that the lines representing importance related to sizes are relatively moving together. Moreover, the movement of these lines seems not compatible with the mean values, which might indicate that these lines are not related to the mean value. Therefore, it might indicate that what the participant has considered important in general is not matching what they believe is important for a specific size.

Nevertheless, this separation between factors' importance in general and factors' importance related to a specific size might be a result of a different attitude in answering "scale questions" differently than "list questions" where the answers should be more exact.

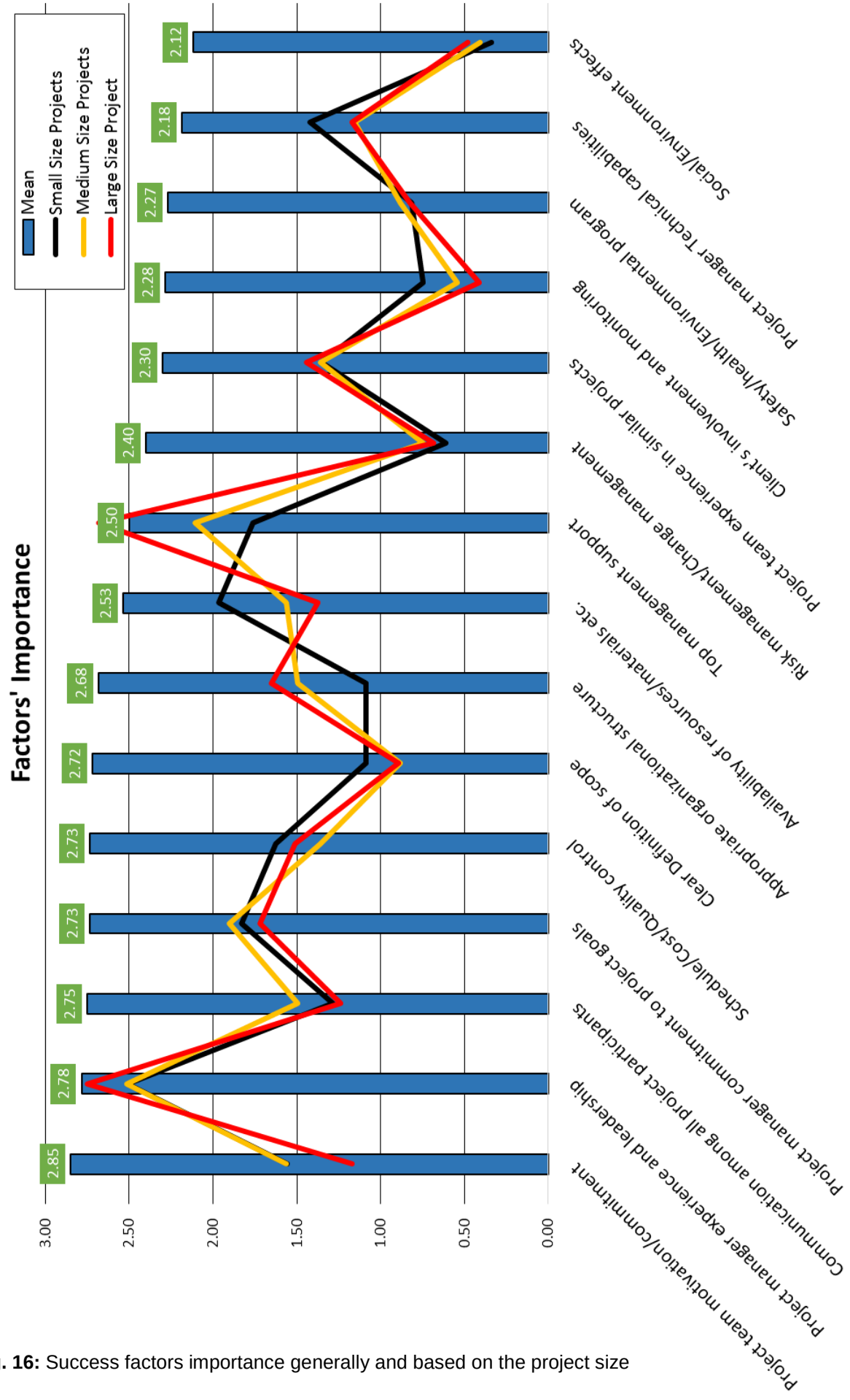

Fig. 16: Success factors importance generally and based on the project size

4.5 Analyzing Correlations between Success Factors

The strength of the linear relationship among the success factors of construction project themselves as well as the project sizes will be determined by using the correlation coefficient. This coefficient represents how tow variables are related. It can take values between -1, which means that the two variables are precisely linearly related but when one of them is increasing the other is decreasing, and +1, which also means that the two variables are precisely linearly related and they increase and decrease together. (Saunders, et al., 2009) The values by which the coefficient can range and the meaning of each value is shown in the figure (Fig. 17) below.

Fig. 17: Values of correlation coefficient **(Saunders, et al., 2009)**.

In this research, the correlation coefficient will be calculated for different possible relations. In the coming parts of this chapter, the names of the factors will be coded as illustrated in the table (Tab. 15)

F1	Top management support
F2	Project manager experience and leadership
F3	Project manager commitment to project goals
F4	Project manager Technical capabilities
F5	Project team motivation/commitment
F6	Project team experience in similar projects
F7	Appropriate organizational structure
F8	Communication among all project participants
F9	Availability of resources/materials etc.
F10	Social/Environment effects
F11	Risk management/Change management
F12	Safety/health/Environmental program
F13	Schedule/Cost/Quality control
F14	Client's involvement and monitoring
F15	Clear Definition of scope

Tab. 15: Coding Success Factors

4.5.1 Correlation between success factors

When calculating the correlation coefficient between the 15 construction projects' success factors without taking into consideration the project size, the results were as shown in the table (Tab. 16) below. The results show that success factors, in general, have medium to no relation at all. Which means in general – without taking the size in the account – the existence of a success factor is not depending or related to another.

However, some factors have medium strength relation like top management support and the existence of health and safety program. That could suggest that it is recommended to focus on health and safety program whenever the top management support is to be considered as a factor of success.

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
F1	1														
F2	0.3	1													
F3	0.1	0.4	1												
F4	0.1	0.3	0.2	1											
F5	0.1	0.4	0.3	0.2	1										
F6	0.1	0.1	0.3	-0.1	-0.1	1									
F7	0.3	0.0	0.2	0.1	0.2	0.3	1								
F8	-0.1	0.1	0.1	0.1	0.3	0.0	-0.1	1							
F9	0.4	0.1	0.1	0.1	0.2	0.2	0.3	0.3	1						
F10	0.2	0.0	-0.1	0.1	0.1	0.0	0.4	0.1	0.5	1					
F11	0.1	0.0	0.3	0.1	0.1	0.3	0.2	0.1	0.2	0.3	1				
F12	0.5	0.2	0.1	0.1	0.0	0.3	0.3	0.0	0.4	0.4	0.1	1			
F13	0.3	0.3	0.2	0.2	0.0	0.2	0.5	0.1	0.1	0.2	0.3	0.4	1		
F14	0.1	0.2	0.2	0.5	0.1	0.1	0.3	0.0	0.0	0.1	0.1	0.2	0.2	1	
F15	0.2	0.1	0.4	0.1	0.2	0.1	0.1	0.3	0.3	0.1	0.2	0.0	0.1	0.2	1

Tab. 16: Correlation coefficient between success factors - Generally

The same argument can be applied for the other factors that have a medium correlation coefficient such as having a good control over schedule, cost and quality will require an appropriate organizational structure. This discussion can be extended to all factors with a medium correlation coefficient.

On the other hand, when the same coefficients were calculated for factors within small, medium, and large projects separately, the results were different from what was obtained when the factors were chosen regardless of size. Appendix E shows the result of calculating correlation coefficients between success factors within each size separately. The medium strength correlation factors among success factors regarding each project size are shown in the table (Tab. 17).

Small Size		
Top management support	Communication among all project participants	-0.3
Project team motivation/commitment	Communication among all project participants	0.3
Project team experience in similar projects	Communication among all project participants	-0.3
Availability of resources/materials etc.	Project manager experience and leadership	-0.3
Availability of resources/materials etc.	Project team motivation/commitment	-0.4
Medium Size		
Project manager experience and leadership	Project team motivation/commitment	0.4
Project manager experience and leadership	Safety/health/Environmental program	-0.3
Project team motivation/commitment	Availability of resources/materials etc.	-0.4
Schedule/Cost/Quality control	Project manager Technical capabilities	-0.3
Schedule/Cost/Quality control	Project team motivation/commitment	-0.3
Large Size		
Top management support	Communication among all project participants	-0.3
Project manager experience and leadership	Project team experience in similar projects	0.4
Project manager experience and leadership	Client's involvement and monitoring	-0.5
Project team motivation/commitment	Availability of resources/materials etc.	-0.3
Appropriate organizational structure	Safety/health/Environmental program	-0.4

Tab. 17: Correlation coefficient for success factors – Small, Medium, Large

The table above also shows that appropriate organizational structure and safety, health and environmental program are negatively correlated in large projects, whereas the correlation was positive when size was not considered. These differences confirm the result that was discussed above (see: 4.4.5 Comparing Factors for Different Sizes) that it is possible that choosing success factors, in general, differs to choosing the factors for precise size.

4.5.2 Correlation between sizes for success factors

Correlation coefficients were also calculated to quantify the relation between the project sizes, which was discussed above (see: 4.4.5 Comparing Factors for Different Sizes). The result of this calculation as a table (Tab. 18) shows a very strong relation between the sizes which is close to +1.

	Small	*Medium*	*Large*
Small	1		
Medium	0.920	1	
Large	0.836	0.946	1

Tab. 18: Correlation between sizes for success factors.

This strong correlation might indicate that the success factors that lead the construction project to success are not related to the size of the project, contrary to what many researchers have argued (Nguyen, et al., 2013; Shokri-Ghasabeh & Kavousi-Chabok, 2009; Hussein, 2013; Silva Susil, et al., 2015; Beleiu, et al., 2015; Gudienėa , et al., 2013).

Medium and large projects are very strongly correlated with a correlation coefficient equal to 0.95, next comes the correlation between small and medium size projects, and at last comes the correlation between small and large projects, which might be logical since medium and large size projects are more alike than small and large ones.

5. Conclusion and Recommendations

5.1 Conclusion

The literature review that was conducted in this research showed the importance of success in construction projects since the construction industry is playing a remarkable and a growing role in national economies. Nevertheless, the researchers are still unable to give a clear, precise, and common definition of projects' success, construction projects' success criteria, or even the factors that lead to success. In addition, researchers have presented numerous techniques for grouping success factors or measuring success. This diversity in research directions in the field limits the possibility of building new researches on a concrete base; therefore, common measures or standards for success criteria and success factors might enhance the efficiency and liability of conducting a research in the field.

During the research, it was noticed by the researcher that all collected previous publications have dealt with success without taking into account project attributes, except when a specific case study was considered. This might be a limitation facing this field of study, and resulting in general conclusions, which do not really enhance the literature, the practical implication or the industry in general. Therefore, this research tried to overcome this limitation by studying success in relation to project size.

Regarding determining success factors for construction projects, this research identified the difference between determining success factors in general and determining success factors in relation to projects' sizes. Project team motivation and commitment is the most important factor when success in general considered Project manager's experience and leadership is the second important factor and followed by communication among all project participants, project manager commitment to project goals, and having good control over time, cost, and quality. On the other hand, when sizes were considered, the most important factors were top management support, the project manager's experience and leadership, and the project manager's commitment to project goals. It should be noted that the last two factors are among the most important factors for construction project whether the size was considered or not, which emphasizes its importance.

Concerning the correlation between success factors, the research's results show that the strength of the linear relation between the success factors ranges from weak to medium. This correlation could be used to couple two factors or more while considering choosing success factors for a project. That being said, it might be possible to conclude that the success factors are affecting the project separately since they do not have a strong correlation.

Contrary to what is currently believed, this research's results show that the size of the project has a minor effect on the related success factors, which means that the same factors have almost the same importance in different project sizes. Nevertheless, this does not include all success factors. Some factors such as appropriate organizational structure have a crucial importance in large projects, whereas, it has less importance in medium and small size projects. Therefore, having a set of factors that are important regardless of the project size, and another set of factors that have different importance in different project sizes is the best way to interpret the relation between success factors and project size.

In summary, the result of this work shows that the majority of the success factors in a construction project can be generalized over different sizes of projects. On the other hands, some success factors are more important in specific sizes.

5.2 Recommendation

1. Since this research was limited to only 15 success factors out of which the five most important were chosen, the research might not reflect the full image of the topic. Therefore, a wider research that could be conducted using more success factors and reaches a bigger number of professionals might be beneficial.
2. Conducting studies that research categories of the projects based on different attributes might be useful as the literature lack to such researches especially when project size is considered.
3. Since the project management field of study is rapidly growing, it might be of an importance with the current technological developments to divide project management based on the project attributes, which enhance the outcome of the specialized management.

4. A common set of success factors related to a project based on its attributes in addition to defined success criteria determined and documented prior starting the project could be included in the contract, which makes it binding for all project participants. This might guide the participant to enhance the likelihood of success.
5. Further similar studies that combine project success with other attributes of the project might light up other areas of project management that still need development.

Declaration of Authorship

I hereby declare that the attached Master's thesis was completed independently and without the prohibited assistance of third parties, and that no sources or assistance were used other than those listed. All passages whose content or wording originates from another publication have been marked as such. Neither this thesis nor any variant of it has previously been submitted to an examining authority or published.

Date

Signature of the student

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Appendix

Appendix A

Appendix A 1: Questionnaire cover letter

Critical Success Factors in Construction Projects

Your views on critical success factors in construction projects

HTW University of Applied Science
Wilhelminenhofstraße 75A
12459
Berlin
Germany

Student: Waseem Alshami

Dear Sir/Madam,

This questionnaire is part of a research project to determine the critical success factors affecting the construction projects based on the project size. Your responses are important in enabling me to obtain an understanding as full as possible of this topic issue.

The questionnaire should take you about 5 minutes to complete. Please answer the questions and feel free to add comments. The information you provided will be treated in the strictest confidence. You will notice that you are not asked to include your name or address anywhere on the questionnaire.

The answers from your questionnaire and others will be used as the main data set for my research project for my Master degree in Construction and Real Estate Management at HTW Berlin University of Applied Science.

I hope that you will find completing the questionnaire enjoyable. If you have any further questions or would like further information, please do not hesitate to telephone me or E-mail me on the phone and Email that are mentioned below.

Thank you for your help.

Waseem Alshami
Email: s0557596@htw-berlin.de
Tel: 009417643362314

Appendix A 2: Questionnaire, questions 1 - 3

Considering that **Time**, **Cost**, **Quality** and **Client's Satisfaction** are the success criteria to which the project success is measured. Please answer the following questions:

Q1. What is your educational level?

- O No Education
- O Secondary School
- O University degree
- O Master Degree
- O Doctoral degree

Q2. Years of experience in construction industry.

- O 1-5 Years
- O 5-10 Years
- O Above 10 Years

Q3. In which project sizes have you worked (you can choose more than one answer)?

- O Small size projects (less than $5 Million)
- O Medium size projects (From $ 5 Million to $500 Million)
- O Large size projects (more than $ 500 Million)

Appendix A 3: Questionnaire, question 4

Q4. In your experience, how important are these factors to achieve success in construction projects generally (if there are factors more important please add them)?

	Not Important	Medium Importance	Very Important
Top management support	O	O	O
Project manager experience and leadership	O	O	O
Project manager commitment to project goals	O	O	O
Project manager Technical capabilities	O	O	O
Project team motivation/commitment	O	O	O
Project team experience in similar projects	O	O	O
Appropriate organizational structure	O	O	O
Communication among all project participants	O	O	O
Availability of resources/materials etc.	O	O	O
Social/Environment effects	O	O	O
Risk management/Change management	O	O	O
Safety/health/Environmental program	O	O	O
Schedule/Cost/Quality control	O	O	O
Client's involvement and monitoring	O	O	O
Clear Definition of scope	O	O	O

Appendix A 4: Questionnaire, question 5-6

Q5. Please choose only the five most important success factors for small projects based on your experience.

O	Top management support
O	Project manager experience and leadership
O	Project manager commitment to project goals
O	Project manager Technical capabilities
O	Project team motivation/commitment
O	Project team experience in similar projects
O	Appropriate organizational structure
O	Communication among all project participants
O	Availability of resources/materials etc.
O	Social/Environment effects
O	Risk management/Change management
O	Safety/health/Environmental program
O	Schedule/Cost/Quality control
O	Client's involvement and monitoring
O	Clear Definition of scope

Q6. Please choose only the five most important success factors for medium projects based on your experience.

O	Top management support
O	Project manager experience and leadership
O	Project manager commitment to project goals
O	Project manager Technical capabilities
O	Project team motivation/commitment
O	Project team experience in similar projects
O	Appropriate organizational structure
O	Communication among all project participants
O	Availability of resources/materials etc.
O	Social/Environment effects
O	Risk management/Change management
O	Safety/health/Environmental program
O	Schedule/Cost/Quality control
O	Client's involvement and monitoring
O	Clear Definition of scope

Appendix A 5: Questionnaire, question 7

Q7. Please choose only the five most important success factors for large projects based on your experience.

O	Top management support
O	Project manager experience and leadership
O	Project manager commitment to project goals
O	Project manager Technical capabilities
O	Project team motivation/commitment
O	Project team experience in similar projects
O	Appropriate organizational structure
O	Communication among all project participants
O	Availability of resources/materials etc.
O	Social/Environment effects
O	Risk management/Change management
O	Safety/health/Environmental program
O	Schedule/Cost/Quality control
O	Client's involvement and monitoring
O	Clear Definition of scope

Appendix B

Appendix B. 1: Grouping and categorizing success factors.

Name	Ghasabeh & Chabok, 2009	Ashley, 1986	Paksereshт & Asgari, 2012	Salleh, 2009	Silva et al., 2015	Babu & Sudhakar, 2015	Babu, 2015	Pinto & Slevin, 1987	Sanvido et al., 1992	Belassi & Tukel, 1996	Cheng et al., 2000	Chau et al., 2001	Cook-Davies, 2002	Al-Zahrani, 2013	Chan et al., 2004	Beleiu et al., 2013	Maghsoodi & Khalilzadeh, 2(	Szentes, 2004	Nilashi et al., 2014		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
Project manager																					
																					0
																					0
Project Team																					
																					0
																					0
Top Management																					
																					0
																					0
Client and Stakeholders																					
																					0
																					0
Planners / consultants / Contractor																					
																					0
																					0
Plans / Schedules																					
																					0
																					0
Other																					
																					0
																					0
Finance																					
																					0
																					0
Risk																					
																					0
																					0
Organization																					
																					0
																					0
Procurement / Logistic / Site																					
																					0
																					0
Contract / Tender																					
																					0
																					0
Social / Cultural / Environmental																					
																					0
																					0
Quality																					
Time																					

Appendix C

	Ghasabeh & Chabok, 2009	Ashley, 1986	Paksereshт & Asgari, 2012	Salleh, 2009	Silva et al., 2015	Babu & Sudhakar, 2015	Babu, 2015	Pinto & Slevin, 1987	Sanvido et al., 1992	Belassi & Tukel, 1996	Cheng et al., 2000	Chau et al., 2001	Cook-Davies, 2002	Al-Zahrani, 2013	Chan et al., 2004	Beleiu et al., 2013	Maghsoodi & Khalilzadeh, 2017	Szentes, 2004	Nilashi et al., 2014	Count
Ref No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Project manager technical capabilities		✓		✓						✓				✓	✓				✓	6
project manager experience & leadership			✓	✓		✓	✓			✓				✓	✓	✓	✓	✓	✓	11
Project manager commitment to project goals		✓		✓		✓				✓				✓	✓		✓		✓	8
Project manager communication skills										✓				✓	✓			✓		4
project manager planning skills															✓				✓	2
project manager adabtability to changes															✓				✓	2
Project team forming method			✓	✓					✓											3
Project team experience in similar projects			✓	✓			✓		✓					✓				✓		6
Project team motivation/commitment		✓		✓	✓	✓	✓			✓	✓	✓								8
project team experience / technical background										✓				✓		✓	✓			4
project team communication skills										✓										1
Top management support	✓				✓	✓		✓		✓	✓				✓	✓	✓			9
Ability to deal with consultant and client in meetings			✓																	1
client clear and precise definition of project goals			✓												✓	✓				3
Client's financial capability					✓										✓					2
Client's involvement & monitoring					✓			✓							✓	✓	✓			5
Client's experience					✓							✓			✓				✓	4
Changes by Clients					✓										✓					2
Clients characteristics					✓					✓					✓	✓				4
Stakeholder satisfaction	✓							✓								✓				3
Client's organizaiton size															✓					1
Client emphasis on low cost/high quality/quick construction															✓				✓	2
Using Expert Consultants in Design			✓																	1
Consultant's competence/skills			✓		✓															2
Contractor's experience					✓							✓								2
Project strategic planning			✓														✓			2
Regulations & standards in construction			✓		✓															2
Detailed planning, estimations and scheduling					✓		✓	✓									✓			4
Integration design and build operation					✓															1
planning accuracy by design team			✓													✓				2
Activities Sequencing		✓					✓							✓						3
Scope clarity		✓		✓	✓			✓									✓			5
Control systems		✓		✓												✓	✓		✓	5
Tax policies					✓															1
Advanced technologies/equipment					✓		✓								✓					3
Project complexity							✓								✓				✓	3
Trust between project participants					✓															1
Safe Working Environment			✓																	1
Corruption and favourism					✓															1
Allocation and control of manpower					✓															1
Clarity of roles and responsibilities					✓											✓		✓		3
IT usage / Knowledge					✓									✓						2

	Ghasabeh & Chabok, 2009	Ashley, 1986	Paksereshtt & Asgari, 2012	Salleh, 2009	Silva et al., 2015	Babu & Sudhakar, 2015	Babu, 2015	Pinto & Slevin, 1987	Sanvido et al., 1992	Belassi & Tukel, 1996	Cheng et al., 2000	Chau et al., 2001	Cook-Davies, 2002	Al-Zahrani, 2013	Chan et al., 2004	Beleiu et al., 2013	Maghsoodi & Khalilzadeh, 2017	Szentes, 2004	Nilashi et al., 2014	Count
Ref No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Site management, control & coordination					✓															1
Project monitoring/progress meetings					✓													✓		2
Sub: Manage and control subcontractors' work					✓										✓				✓	3
Lack of opportunities for R&D					✓															1
Using innovative building materials					✓		✓													2
Communication among all project participants					✓	✓	✓	✓			✓				✓	✓	✓			8
Project Type/Nature Related Factors					✓										✓				✓	3
Project problems analysing			✓																	1
Feasibility studies			✓		✓															2
Decision making on-time			✓																	1
Decision making Mechanism			✓																	1
Project control management			✓																	1
Using lesson learned							✓						✓					✓		3
Subcontractors competencies										✓										1
Project size										✓					✓				✓	3
density of project life cycle										✓										1
Conflict resolution/troblshooting							✓			✓	✓									3
creativity											✓									1
constrains imposed by end user												✓								1
Changes control process													✓					✓		2
Documentation													✓	✓						2
Project management techniques usage																✓				1
Technical skills usage																✓				1
Considering Inflation/economic crisis in financial programming			✓		✓															2
Adequate profit margins					✓		✓													2
Banking support/low interest rates					✓															1
Project monitoring / cash flow management					✓		✓													2
High inflation rate/fluctuation of material price					✓		✓													2
Administration and bureaucracy					✓															1
Adequate funds/cash flow management					✓		✓							✓			✓			4
Authorization in Financial decision considering project type and size			✓																	1
Mechanism of payment in relation to Plan			✓																	1
Overhead percentage of project							✓													1
Cost of Project design							✓													1
Cost of Material & Equipment							✓													1
Cost of Project labor							✓													1
Cost of Project overtime							✓													1
Average delay in regular payments							✓													1
Cost of Change							✓													1
Cost of compliance to regulators requirements							✓													1
project value										✓										1

	Ghasabeh & Chabok, 2009	Ashley, 1986	Paksereshtt & Asgari, 2012	Salleh, 2009	Silva et al., 2015	Babu & Sudhakar, 2015	Babu, 2015	Pinto & Slevin, 1987	Sanvido et al., 1992	Belassi & Tukel, 1996	Cheng et al., 2000	Chau et al., 2001	Cook-Davies, 2002	Al-Zahrani, 2013	Chan et al., 2004	Beleiu et al., 2013	Maghsoodi & Khalilzadeh, 2017	Szentes, 2004	Nilashi et al., 2014	Count
Ref No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Economical situation										✓					✓		✓		✓	4
Turn Over history														✓						1
Bonding Capacity														✓						1
Risk management / Change management			✓		✓							✓	✓			✓		✓		6
Evaluating subcontractors before signing the contract			✓																	1
Climate condition							✓													1
Risk awarness /registeration													✓				✓			2
Ability to handle unexpected problems																✓				1
Manpower/labour productivity					✓															1
Effective document control system					✓															1
Adequate trainings & skill development programs					✓															1
Adequate career development programs					✓															1
Appropriate organizational structure				✓	✓					✓			✓		✓			✓	✓	7
Market share of organization							✓							✓						2
Quality assessment system in organization							✓													1
Management-labor relationship							✓													1
Organization age in business														✓						1
Availability of resources/materials etc.	✓				✓		✓				✓			✓			✓	✓		7
Assessment of project required resources			✓																	1
Appropriate utilization of project machineries and equipment's			✓																	1
Purchasing priority according to project schedule			✓																	1
Clear and detailed procurement process & strategy					✓															1
Procurement system/Method					✓										✓				✓	3
Waste rate of materials							✓													1
Site preparation time							✓													1
Percentage of orders delivered late							✓													1
Site condition problems / Site organisation							✓							✓						2
Recommending the lowest responsive tenders					✓															1
The ambiguousness of contractual terms and conditions					✓															1
Effective contract management / administration system					✓				✓					✓						3
Tendering method															✓				✓	2
Tender awarded to competent contractors																	✓			1
Safety, health and environmental standards /program			✓	✓	✓									✓	✓				✓	6
Low government/political support & political instability					✓												✓			2
Social/ environment effects					✓			✓		✓				✓	✓		✓		✓	7
Nature/ecological/physical environment					✓					✓					✓					3
Reportable accidents rate in project					✓															1
Effective quality assurance programme					✓									✓	✓					3
Number of rework incidents							✓													1
uniqueness of project activities										✓										1
Time needed for rework/change							✓													1
Average delay in claim approval							✓													1
Urgency								✓		✓							✓			3
Project duration less than 3 years													✓							1

Appendix D

Appendix D-1: Semi-structured interview questions.

1. **Questions related with the interviewee:**

A. What roles have you played in construction projects?
B. In which type of projects have you worked before?
C. In which size of projects have you worked before?

2. **Questions regarding construction project success**

A. In your opinion, what makes a construction project successful?
B. How do you evaluate the success of your last project in term of time, quality, cost and client's satisfaction?
C. How do you think success factors differ from project to another?

3. **Questions about success factors effect on the project.**

A. Do you think success factors differ from one project to another based on size?
B. Do you think that project management's success factors have the same effect on construction project success as on management success?
C. Do you think project management is an important factor to reach project success?
D. How do you evaluate the effect of top management in reaching success?
E. How do you think a client could affect project success?

4. **Please go through these 15 success factors, do you think there is a better way to represent success factors while keeping the same quantity of factors?**

5. **Please go through this questionnaire and provide your feedback regarding the questions, the length, the language, the layout of the questionnaire or any other relevant feedback.**

Appendix D-2: Semi-structured interview answers summary.

Questions	Interviewee 1	Interviewee 2	Interviewee 3
1.A	Project manager	Senior Architect	Construction manger
1.B	Infrastructure project	Hotel	Health center
1.C	Medium and large	Large	All Sizes
2.A	There are several factors that lead to project success, but the most important is having support from the company	Having a clear vision of the owner, available resources, on time payment. Using new technology could also help in to reach success	Many factors can lead to a project success; the most important is having a commitment to the goals and work together as a team.
2.B	Successful, however, it was over budget due to changes	Delay payments resulted in a delay in construction	Successful
2.C	Each project have success factors that are different from the other project, project are unique and their success factors as well	Success factors differ based on the type, size, and client of the project	some factors differ from one project to another while other factors might be general
3.A	Yes, size could reflect project features like complexity and importance, so success factors change with it	Yes, a bigger project size needs more detailed planning to reach success	Yes, the factors that lead a small project to success will be different from those for large projects
3.B	Maybe not exactly the same but for sure it is very essential to reach success	Management success can enhance project success	Management success is the most important factor to reach project success
3.C	Yes for sure	Yes	Yes, very important
3.D	Very important	Very important	Very important

3.E	Yes, the client should facilitate a timely payment and reduce changes to reach success	Yes, when a client ask for many changes the risk of failure increase	changes come from the client, reducing them increase success likelihood
4	I would remove “project manager technical capability” and divide “risk and change management into two factors”	Delete one factor regarding the project team and add “having accurate on-time plans”	I think they are good, it is better to add on-time payments, it is very important
5	It is clear and can be done quickly	Add five degrees of importance in the third question	Add categories for the factors.

Appendix E

Appendix E-1: Correlation coefficient between success factors for **small projects**.

Small Size	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
F1	1														
F2	-0.2	1													
F3	-0.2	0.0	1												
F4	-0.1	-0.1	0.2	1											
F5	-0.1	0.1	0.1	-0.2	1										
F6	0.1	0.2	-0.2	-0.1	-0.2	1									
F7	-0.2	-0.1	-0.1	0.0	0.1	-0.2	1								
F8	-0.3	0.0	-0.1	-0.2	0.3	-0.3	0.1	1							
F9	0.0	-0.3	-0.2	0.1	-0.4	-0.1	-0.2	-0.2	1						
F10	0.1	0.0	-0.1	0.0	-0.1	0.1	0.0	-0.1	-0.1	1					
F11	-0.2	0.0	-0.1	0.0	0.0	0.1	-0.1	0.0	0.0	-0.1	1				
F12	0.2	-0.1	-0.1	-0.1	-0.2	0.0	-0.3	-0.1	0.2	-0.1	0.0	1			
F13	0.0	0.0	0.0	-0.1	-0.2	-0.2	-0.1	-0.2	0.2	-0.2	-0.1	0.0	1		
F14	0.1	-0.3	-0.2	0.0	-0.3	0.1	-0.1	-0.2	0.1	0.1	-0.1	0.1	-0.1	1	
F15	0.1	-0.3	-0.1	-0.2	-0.1	-0.1	0.0	0.0	0.1	-0.1	-0.2	-0.1	0.0	0.0	1

Appendix E-2: Correlation coefficient between success factors for **medium projects**.

Medium Size	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
F1	1														
F2	-0.2	1													
F3	0.0	-0.2	1												
F4	-0.1	0.1	0.2	1											
F5	-0.2	0.4	0.2	0.0	1										
F6	-0.1	0.2	-0.2	0.2	-0.1	1									
F7	-0.2	0.0	-0.1	0.0	-0.1	-0.1	1								
F8	-0.1	-0.1	-0.2	-0.2	0.1	-0.1	0.2	1							
F9	0.0	-0.2	-0.2	-0.1	-0.4	-0.1	0.0	-0.2	1						
F10	0.0	-0.1	-0.2	-0.1	0.1	0.1	-0.2	-0.1	0.0	1					
F11	0.0	-0.1	-0.1	-0.2	-0.1	0.1	-0.1	-0.1	0.0	-0.1	1				
F12	0.1	-0.3	0.1	-0.1	-0.3	0.0	-0.3	-0.2	0.1	0.1	0.0	1			
F13	0.1	-0.2	0.0	-0.3	-0.3	-0.1	0.1	0.0	0.1	-0.2	0.3	0.1	1		
F14	0.1	-0.2	-0.2	-0.2	0.0	-0.1	-0.1	0.0	0.1	0.3	0.0	0.2	-0.1	1	
F15	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.2	0.0	0.3	0.0	-0.3	-0.1	-0.2	-0.1	1

Appendix E-3: Correlation coefficient between success factors for **large projects**.

Large Size	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
F1	1														
F2	-0.2	1													
F3	0.0	0.0	1												
F4	-0.1	-0.1	0.3	1											
F5	-0.2	0.2	0.0	-0.1	1										
F6	-0.1	0.4	-0.2	0.0	0.0	1									
F7	0.1	-0.1	0.1	-0.1	-0.1	-0.1	1								
F8	-0.3	0.1	-0.2	-0.1	0.1	0.0	0.0	1							
F9	0.1	-0.2	-0.2	0.1	-0.3	0.0	-0.2	-0.1	1						
F10	0.0	-0.2	0.0	-0.1	0.1	-0.1	0.0	0.0	-0.2	1					
F11	-0.2	-0.1	-0.1	0.0	0.0	-0.1	0.0	0.1	-0.2	0.2	1				
F12	-0.1	0.2	-0.2	0.0	-0.2	0.1	-0.4	0.0	0.0	0.0	0.0	1			
F13	-0.1	-0.1	-0.3	-0.2	0.0	0.0	0.0	-0.1	0.1	-0.2	0.0	0.0	1		
F14	0.2	-0.5	0.1	-0.1	0.1	-0.2	0.0	-0.1	0.1	0.1	0.0	-0.2	-0.1	1	
F15	0.2	-0.2	-0.2	-0.1	-0.2	-0.2	-0.1	-0.2	0.1	-0.2	-0.2	0.0	0.1	0.0	1