Establishing Hierarchal Structure for Critical Success Factors Affecting High Rise Building Construction Projects in Addis Ababa

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A Thesis Submitted to the Department of Civil Engineering

School of Civil Engineering and Architecture

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Office of Graduate Studies

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DECLARATION

I hereby declare that this Master Thesis entitled "Hierarchal Structuring of Critical Success Factor for High Rise Building Construction Projects in Addis Ababa" is my original work. That is, it has not been submitted for the award of any academic degree, diploma, or certificate in any other university. All sources of materials that are used for this thesis have been duly acknowledged through citation.

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I, the advisor of this thesis, hereby certify that I have read the revised version of the thesis entitled "Hierarchal Structuring of Critical Success Factor Affecting High Rise Building Construction Projects in Addis Ababa," prepared under my guidance by Bisrat Teshome Aragaw, submitted in partial fulfillment of the requirements for the degree of Mater's of Science in Construction Engineering and Management. Therefore, I recommend the submission of the revised version of the thesis to the department following the applicable procedures.

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I, the advisor of the thesis entitled "Hierarchal Structuring of Critical Success Factors for High Rise Building Construction Projects in Addis Ababa" and developed by Bisrat Teshome Aragaw, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

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We, the undersigned, members of the Board of Examiners of the thesis by Bisrat Teshome Aragaw have read and evaluated the thesis entitled “Hierarchal Structuring of Critical Success Factors for High Rise Building Construction Projects in Addis Ababa” and examined the candidate during the open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of the degree of Master of Science in Construction Engineering and Management.

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LIST OF ACRONYMS

AHP	Analytical Hierarchy Process
CSF	Critical Success Factor
ISM	Interpretive Structural Modeling
MICMAC	Matricce d'impacts croises multiplication applique a classment
GDP	Gross Domestic Product
Pm	Project Manager
SAR	Special Administrative Region

ABSTRACT

The increasing scarcity of land as time pass and its high cost for residential and commercial buildings increases the demand for high-rise buildings. On the other hand, construction project failure is on the rise and the failure of such a project will be catastrophic. So, achieving success in constructing high-rise building projects is becoming extremely important. In this regard, few studies have been conducted on critical success factors that affect the construction of high-rise building projects. However, past studies lack consideration for identifying interrelationships between success factors. This requires assessing the possibility that even less critical factors may or may not affects the criticality of the other more critical factors. Therefore, this study aims to identify, prioritize, and develop a hierarchical structure of critical success factor and their interrelationships for high-rise buildings. A total of 31 factors were selected from the literature review and pilot study-related sources. These factors were analyzed using Analytic Hierarchy Process based survey, that resulted in the top 20 factors. These 20 factors were used as input in the Interpretative Structural Modeling survey. The survey was distributed to professionals taking part in a high-rise building project. The integrated method of an Analytic Hierarchy Process and Interpretative Structural Modeling was conducted using Expert Choice and ISM software to analyze the data respectively. The result shows that adequate funds/resources, the economic and financial situation of the contractor, and clear and precise goals by the client were the most important critical success factors. The finding also shows there is a strong interrelation between these factors and the most influential factors are the economic environment, technological environment, the complexity of the project, type of the project, and experience of the client. Considering the combined effect, the adequate funds/resources, economic and financial situation of the contractor, clear and precise goals by the client, decision-making effectiveness of the project manager (Pm), good communication between the Pm and the team, and competency of the consultant are the most critical factors which have strong influence and importance.

Keywords: Critical Success Factors; Analytic Hierarchy Process; Interpretative Structural Modeling; Influence.

CHAPTER ONE

INTRODUCTION

1.1. Background

The construction industry is one of the primary contributors to the national economy and has multiple effects on a country. It accounts for approximately 13% of the global gross domestic product (GDP) which is a measure of the output, employment, and income of the economy. The amount of annual construction activity in the world exceeds one trillion dollars (Chitkara, 2014). In developing countries, construction activities account for around 10% of GDP, or roughly 80% of total capital assets (Tafesse et al., 2022). Furthermore, according to Wibowo (2009) study, the value added of construction in GDP is between 3 and 6 percent for under developing countries. The construction industry is of vital importance for employment and the economic growth of Ethiopia. According to a study conducted by Belay & Woldesenbet (2016), the construction sector has significantly contributed to the national economy of Ethiopia. It has contributed approximately 15.9% of the country's gross domestic product (GDP) value in the 2015/16 fiscal year according to (African Development Bank Group et al., 2017).

Over the past 17 years, the number of high-rise buildings in the world has quadrupled (Radushinsky et al., 2018). According to Yu, (2017) this increase appears concurrently with social development, population growth, and land tension. According to Radushinsky et al. (2018), high-rise buildings are a sign of economic growth and are used by developing countries to attract local and foreign investors. Similarly, in Ethiopia rapid urbanization, rising income levels, expanding industrial sectors, rising demands for education and health care, improved living standards, expansion in the global services sector, and the expansion of multinational organizations across the country have all fueled significant investment in the construction economic sector over the last decade (Sinesilassie et al., 2017). Especially in the residential and real state building sectors. And with the scarcity of land supply, the increasing population has forced most cities in the world to support and encourage the construction of high-rise buildings. Addis Ababa also has followed suit, becoming a jungle of high-rise buildings since the adoption of high-rise solutions for both residential and commercial buildings (Gebremichael, 2016).

But the Construction industry, by its nature, is a complex, project-oriented, high-risk, and competitive business. So, it's prone to failure. Construction project failures are increasingly reported around the globe, and achieving the success of construction projects is becoming extremely difficult in today's turbulent environment (Silva et al., 2015). Project failure has become a common feature of construction projects in developing countries (Nzekwe et al., 2015). Especially in Ethiopia, the case is similar or even worse. According to Nuramo & Chekol (2020), the performance of the Ethiopian construction industry is low. Most construction projects in Ethiopia have not been completed within the schedule and allocated budget in the majority of the cases. According to Koshe & Jha (2016), only 8.25% of construction projects have been finished by the originally targeted completion date. The remaining 80.75% were delayed three times than the targeted contractual time. Similarly, building projects in Ethiopia are surrounded by cost overruns and time overruns. Addis Ababa being the capital city of Ethiopia is home to the majority of the country's building construction projects. Around 57% of these building projects in the city fail to meet the time and cost requirements (Gebrehewot & Shete, 2019). And the failure of such projects especially high-rise buildings will be troublesome since a large amount of budget is allocated to them. So, achieving success is becoming more important in the highly competitive and important industry.

Researchers agree that the existence or absence of specific project attributes can be ascribed to project success. CSFs are those attributes that contribute to and are influential for the successful completion of a project (Alzahrani & Emsley, 2013). On the other hand, determining key success factors in different project contexts is a challenge and it is extremely important for the industry. According to Belay (2021), identifying and analyzing the crucial success factors in a project is one of the most important phases in ensuring the successful delivery of construction projects. The study of project success and critical success factors is widely recognized by different literature as a way to increase project effectiveness and efficiency.

Project success factors have been widely discussed, and lists of important success factors have been compiled, however, there is no consistency and consensus. Critical success factor studies are too generic and raise questions about their application in a specific industry like construction (Silva et al., 2015). So, critical success factors have to be systematically and quantitatively analyzed to predict possible effects, and then choose suitable approaches to deal with them (Anbari, 2004). This is not only vital for monitoring purposes or assessment

of the project status, but also in guiding project managers and policymakers in identifying potential problems and allocating the necessary resources to guarantee project completion and success.

Earlier, few studies have been conducted on critical success factors that affect the construction of high-rise building projects. However, past studies lack consideration for identifying interrelationships between success factors that indirectly affect the efficiency of critical success factors. Notably, some studies have been conducted in developing countries' contexts that focus on CSFs that affect the overall performance, and no research was found on identifying interrelationships between success factors for high-rise building construction projects. In this regard, Ethiopia, being one of the emerging markets in the sub-Saharan African region, faces several challenges in the performance of construction projects (Belay, 2021). Hence, it is imperative to discuss these challenges by studying the critical success factors in high-rise building construction projects located in Addis Ababa by identifying and ranking (hierarchy structuring) them.

1.2. Statement of the Problem

The construction industry is one of the largest industries in Ethiopia, both in terms of its contribution to the GDP of the country and in terms of the number of employments. It employs the second-largest number of people after the agriculture sector (Eyassu, 2020a). Ethiopia's construction industry has experienced rapid growth and is now a major player in the country (MoUDC, 2012). And with the cost of land and the population increasing, especially in the capital city Addis Ababa, the city is becoming a jungle of high-rise buildings. Since the high-rise solution has been adopted for both residential and commercial buildings (Gebremichael, 2016). With that, the number of high-rise building projects in the city is on the rise. But the construction industry suffers the most to meet deadlines and budgets and project quality (Hailemarkos, 2020). In which the construction schedule slippage reached 80% and the rise in cost reached 40% (Ayalew et al., 2016). Furthermore, creating a large facility like a high-rise building takes a long time and usually involves an enormous capital investment (Gould, 2011; Nega, 2008). Because of that, such projects' cost overruns, delays, and other problems are proportionally monumental (Gould, 2011). So, the successiveness of such projects is mandatory.

Researchers agree that the majority of reasons for project success can be attributed to the presence or absence of specific project characteristics known as critical success factors.

According to (Belay, 2017), Ethiopia is one of the developing countries that is unable to meet its construction project goals due to a lack of adherence to various important success factors. So, it is a great necessitate to pay attention to critical success factors affecting the success of construction projects, especially high-rise building projects.

Earlier, many studies have been conducted on the issue of critical success factors using different techniques and methods around the world and also in Ethiopia. which include studies like (Belay et al., 2021a; Chan et al., 2004; Gudienė, Banaitis, & Banaitienė, 2013). On the other hand, there is not enough research done on high-rise buildings' success in the world and there is a lack of research on factors affecting the success of high-rise buildings in Ethiopia. Also, the studies that exited and done on the building and construction industry in general assess and prioritize critical success factors using the relative importance of such factors to the success of the project only, but critical success factors are not independent and they have strong interrelationship (Chen et al., 2012; Liu et al., 2016). Because of that, it is not enough to prioritize critical factors based on only their relative importance to success, because the most important critical success factor may be affected or influenced by the critical success factors which are prioritized lower (less critical). On the other hand, it cannot be prioritized only based on the influence of that factor on other factors because the most influential factor may not be the most important factor to success.

So, to get the complete picture and prioritize and also allocate the appropriate resource, critical success factors have to be identified, analyzed, hierarchically structured, and prioritized based on their relative importance to the success and based on the influence of one factor on other factors. Therefore, this study focuses on identifying, analyzing, and hierarchically structuring of CSFs in Addis Ababa high-rise building construction projects to bring structural clarity and establish a hierarchical structure using both relative importance weight and influence of one factor on the other to prioritize critical success factors for allocation of proper resource and to contribute to the efficiency of delivering of high-rise building construction projects.

1.3. The Objective of the Study

1.3.1. General Objective of the Study

The general objective of this study is to identify CSFs related to high-rise building construction projects in Addis Ababa city and hierarchically structure those CSFs using both their importance to the success of the project and the influence of one factor on the other.

1.3.2. Specific Objectives of the Study

- To structure critical success factors for high-rise building construction projects based on the relative importance of success
- To structure critical success factors for high-rise building construction projects based on the influence of one factor on the other factor
- To establish hierarchical structure for success factors affecting high-rise building construction projects based on the combined effect of importance and influence

1.4. Research Questions of the study

1 Which factors are the most important to the success of high-rise building construction projects?

2 Which factors influence the other factors the most?

3 Which factors are influential to other factors and also important to the success of high-rise building construction projects?

1.5. Scope of the Study

This study was confined to identifying, hierarchically structuring, and prioritizing critical factors affecting high-rise building construction projects' efficient and successful completion that have to be taken into consideration to cope with the challenges faced by high-rise building construction projects in Addis Ababa. The study is focused on high-rise building construction projects in the city of Addis Ababa currently in progress and almost 75 percent or more completed. This is done to get factors affecting projects and not products and in doing that to get proper information by conducting the study on projects which have enough progress to get proper output.

1.6. Limitation of the Study

There was a limitation on finding properly organized and compiled data in the Addis Ababa City Administration Building Permit and Control Office, which made it difficult and time-consuming to find the number of the population for the study.

1.7. Significance of the study

The study gives insight to different stakeholders in the construction industry about the critical factors for project success. Furthermore, it empirically informs decision-makers and other stakeholders about the problem at hand, which factors affect the success of the construction project, and which factor to prioritize. It also suggests potential research areas

in addition to its purpose as empirical evidence for further studies. These factors will extend great guidelines when undertaking any project in the construction industry.

1.8. Research Organization

The research is organized into five chapters. Introduction, literature review, methodology, result and discussion, and conclusion are the chapters from one to five, respectively.

Chapter One: - Introduction

The introduction part includes: - the background of the study, a statement of the problem, objectives of the study, significance of the study, research question, scope of the study, and limitation of the study.

Chapter Two: Literature review

This chapter encompasses relevant related literature on the concept and overview of project success factors, what are project success and project success factors, and also what are the criteria for success and the general concept of project management?

Chapter Three: Methodology

This chapter covers how the research is carried out and covers the research method, target population, instruments of data collection, data collection techniques, and procedures, and the data analysis method.

Chapter Four: Result and Discussion

This chapter presents the analysis of data that is collected from the questionnaires and interview. Presents detailed analysis of the AHP and ISM calculation, and results from the analysis.

Chapter Five: Conclusion and Recommendations

This chapter presents the conclusion based on the result and the recommendation based on the conclusion.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

In this literature review, contents related to construction project success, especially high-rise building project success, were covered. This chapter has two major portions. The first one is the theoretical part, which includes the introduction and purpose of the construction industries, the general concept of the project, project success, and critical success factors. It also contains some specific definitions and concepts for high-rise buildings, components of success, and success criteria and measurement. The second part contains the empirical part of this chapter, which includes the review of empirical research and their summary and also the gaps identified from them.

2.2. General Overview of the Construction Industry

According to Gruneberg (1997), construction is an economic activity that encompasses the entire construction process, from the production of raw and manufactured building materials and components to the provision of professional services such as design and project management to the physical execution of the work on site. Construction can also be viewed as an economic activity that focuses solely on the final stage of the construction process, which is the physical work performed on the production site (Pheng & Hou, 2019a). In this context, all services, such as project management, planning, and design, as well as offsite manufacturing and supply of building materials, are excluded from this perspective of construction. Somehow, the better explanation for it lies between the two extremes.

The construction industry is crucial to the socio-economic success of any country. The industry's operations are critical to achieving national socio-economic development goals, such as infrastructure, housing, and employment (Oladinrin et al., 2012). In both developing and developed countries, construction plays an important role in economic progress. For developing countries, construction activities and their outputs are a crucial aspect of the national economy and industrial expansion during the development process (Anaman and Amponsah, 2007). It is frequently seen as a stimulant for economic development, particularly in underdeveloped nations. Construction has a noticeable impact on a country's production; it creates jobs and incomes for people, therefore the effects of changes in the

construction sector on the economy may be seen at all levels and in almost every element of life (Rameezdeen, 2007), especially in developing countries like Ethiopia. According to the National Bank of Ethiopia (NBE), construction accounts for half of the industries in Ethiopia. Furthermore, the industry is growing at a rapid rate. The construction industry rose by 37% in 2013/14 alone. Industrial activities accounted for 15% of Ethiopia's total output and the construction sector contributed 7.5 percent of Ethiopia's overall GDP during this period, which can be equated to 9.4% of total output (Falcioni, 2016). Because of this, the construction industry is crucial for Ethiopia's economy.

The construction industry has many special problems, so discussion of the key features of this industry is a necessity. According to MoUDC (2012), the construction industry has witnessed significant changes in recent years because of better technology, greater competition, rising consumer expectations and demands, and limited economic resources. As a result, the sector needs better, knowledgeable, and effective managing abilities to handle challenges arising from these dynamic developments. The importance of taking measures to improve the performance of the construction industry has now been recognized in several countries at various levels of socio-economic development (Loganathan et al., 2017).

2.3. Construction Project

According to Munns & Bjeirmi (1996), a project is a process of achieving a specified objective, which involves a series of activities and tasks that consume resources. In which it gives a more generalized definition by saying having objective rather than listing specific one. This definition was further elaborated by Wysocki (2014), who defines a project more broadly as a sequence of unique, complex, and connected activities that have one goal or purpose and it must be completed by a specific time, within budget, and according to specification.

Most of the time, project and construction projects are used interchangeably. But the construction project is unique from an ordinary project. Taking the definition given by Project Management Institute (2021), a project is a temporary endeavor undertaken to provide a unique product or service. In the case of construction projects, the product is a construction facility that includes civil, mechanical, electrical, telecommunication, and other utility works. Construction by its nature is temporary, each having a predetermined starting and ending timeline, and they are unique every time. The phrase 'unique' here refers to the

fact that each project is distinct from others in some manner, while the term 'temporary' refers to the fact that each project has a defined start and finish date. Based on this construction project is almost similar to that project, but it is slightly different because a construction project possesses certain features that are not present in other types of projects. In this regard, Jha (2011) presented some unique features of a construction project as follows:

- One-time activity, it must be performed correctly the first time every time
- Complexity and multidisciplinary because it involves a set of interrelated tasks to be done by specialists
- High cost and time for execution
- High risk of failure
- Difficulty in defining quality standards
- The uniqueness of people's relationship
- Feedback mechanism
- Lack of experience of client or owner
- Untrained workforce

Knowing these features a construction project can be defined as the sum of planned activities, material or otherwise, of an organization to convert an idea or a design for engineering or construction work to fulfill human or economic needs within limits of quality, cost, and duration (Santana, 1990). This construction project definition was further elaborated by Kumara & Warnakulasuriya (2016), as a mission undertaken to create a construction facility or a service with predetermined performance objectives with the involvement of different project participants with different expectations. Unlike the first one, this definition underlines that each stakeholder has their requirement and expectation which vary from quality, cost, and time to profitability, serviceability, and safety rather than giving a generalized concept.

2.4. Construction Project Success

Determining whether a project is a success or failure is intricate and ambiguous. This is because of the lack of industry-accepted or conventional definition of project success since different project teams are in unique settings and meanings. Their concept of success will differ from one project team to the other. Because of that, the concept of project success has remained ambiguously defined in the construction industry. Its concept and definition are

complex and frequently discussed but rarely agreed upon (Gudienė et al., 2014a). But success is almost the ultimate end product for every construction project. Because of that, there must be some way of expressing success.

The concept and definition of construction project success has been developing over time. Sanvido et al., (1992) defined construction project success as the degree to which project objectives and expectations are satisfied. These objectives and expectations might involve technical, financial, educational, social, and professional components. This study, by providing the above definition, tried to clarify the aspect or measurement for the project to be successful. Furthermore, Nguyen et al. (2004) try to identify some measuring parameters for a construction project to be defined as successful. According to Nguyen et al. (2004), a construction project is successful when it is finished on schedule, under budget, in line with specifications, and to the satisfaction of stakeholders, functionality, contractor profitability, the lack of lawsuits and legal processes, and fitness for purpose for occupiers have all been used as indicators of project success. In this definition, unlike Sanvido et al., (1992), the scope of expressing success was further expanded based on the basic and unique characteristics of construction, by including more criteria related to success.

So, rather than setting or listing criteria and requirements, having a definition that gives a general expression for success is necessary. In this regard, the construction project success definition was given by Kumara & Warnakulasuriya (2016), as the degree to which participants view the achievement of pre-defined performance goals and the execution of construction facilities or services. But, to different participants, project success implies different things. Each sector, project team, and person defines success differently. Success is an intangible perceptual sense that fluctuates with various management expectations, across people, and with project phases (Sanvido et al., 1992). Owners, designers, consultants, contractors, and subcontractors all have their own set of project goals and success criteria. Architects, for example, frequently see aesthetics as the primary success factor, rather than constructing cost. Other aspects, however, may be more important to the client. Furthermore, the same person's view of success might shift from project to project.

Construction Project success, according to Baccarini (1999) is a combination of project management and project product success. To correctly define and analyze project success, the difference should be established between product success and project management success (process success), as the two are not synonymous. The first one which is product

success, the term product success refers to the project's real deliverability and the successful provision of the benefits to the numerous stakeholders engaged with the project, such as users, customers, or project workers (Omezzine, 2017). Product Success focuses on the effects of the project's final product rather than the means to the end. According to Collins & Baccarini (2004) to meet the success of a product, some criteria must be fulfilled, this mainly includes three criteria and they are:

- Meeting the strategic organizational goals of the project owner (goal)
- Meeting the demands of users (purpose)
- Satisfy stakeholders in areas where they have a connection to the product (mainly customers/users)

On the other hand, project management success or process success is focused on the project process and, in particular, the attainment of cost, time, and quality objectives. It also examines how the project management process was carried out (Baccarini, 1999). This shows that it is focused on the project process or the means to the end rather than the end product itself. According to Collins & Baccarini (2004), project management process-related success requirements contain three criteria:

- Meeting time, cost, and quality objectives
- Quality of the project management process
- Satisfying stakeholders during the project management process (primarily sponsor and project team)

These classic requirements are still the most commonly used measurement for project success.

2.4.1. Measurement of Construction Project Success and Success Criteria

Chan (2001), described construction project success criteria as a norm of judgment or a principle by which a project is valued. This study further generalizes it by saying criteria are a set of principles that enable favorable outcomes to be achieved within a given set of specifications. Similarly, Silva et al. (2015) designated project success criteria as the standards by which a project's success or failure is measured. These criteria are the dependent variables (principles, measures, standards) that measure and evaluate the successful outcome of a project. The project success criteria are quantifiable phrases that describe what the project's ultimate result should be in terms that are acceptable to the end user, customer, and

stakeholders. There is no valid explanation for the term project success. However, it is early acknowledged that the criteria for determining if a project is successful must be determined in the project's life cycle to minimize any disagreements amongst project teams.

It is customary to define success through the iron triangle, which includes time, cost, and quality. However, the iron triangle of time, cost, and quality have been expanded to include other factors in determining the success of a project (Alashwal et al., 2017). Success is viewed differently by different project stakeholders and should be judged from the perspective of several stakeholders, including the project owner, users, contractors, and the management team. For example, the project manager may view success as the completion of a project within the established time, cost, and quality parameters (Frefer Aa et al., 2018). Users may judge a product's success based on its functioning (i.e., the building). Contractors' success can be judged in terms of project profit, on-time completion, safety, the number of claims, and commercial performance (Sanvido et al., 1992a). As a result, success has been expanded to include product success and project process success (Baccarini, 1999).

The number of success criteria has increased over time. But based on the characteristics of these criteria, a grouping mechanism can be created. One such mechanism is to divide them into two short-term and long-term criteria by considering the time to realize the success. Success criteria can be classified into efficiency (short term) and effectiveness (long term) measuring criteria (Kumara & Warnakulasuriya 2016). According to this study, budget, time, safety, and specifications deal with the measurement of efficiency (short-term goal), whereas, effectiveness (long-term goal) measures include user satisfaction, environmental impact, and profitability. But for the sake of the current research, the three basic criteria which are time, cost, and quality were primarily used as a criterion for measuring the success of the project which are given in Figure 2.1.

2.4.2. Importance of Setting Success Criteria

From the definition of success criteria, we have seen that criteria are means of measuring or judging the success of the project. Participants of the project can benefit from knowing the success criteria so they can work toward those objectives while delivering project deliverables. The following are some of the advantages of defining and measuring project success by setting success criteria as given by Indeed (2021):

- Setting benchmarks: Setting benchmarks to monitor a team's progress toward the end goals can be made easier by project managers when they are aware of the

requirements for project success. Reducing project risks: Understanding project success criteria can assist project managers in identifying factors that may affect project success and taking steps to reduce those risks.

- Increasing engagement: Defining and tracking project success can help the project team and other stakeholders, such as clients, become more engaged.
- Creating transparency: Setting project success criteria can help to create transparency among stakeholders by ensuring that everyone understands the project's expected outcomes.
- Improving future projects: By determining what went well and where improvements can be made, taking the effort to define and measure project success can assist in enhancing procedures for subsequent projects.

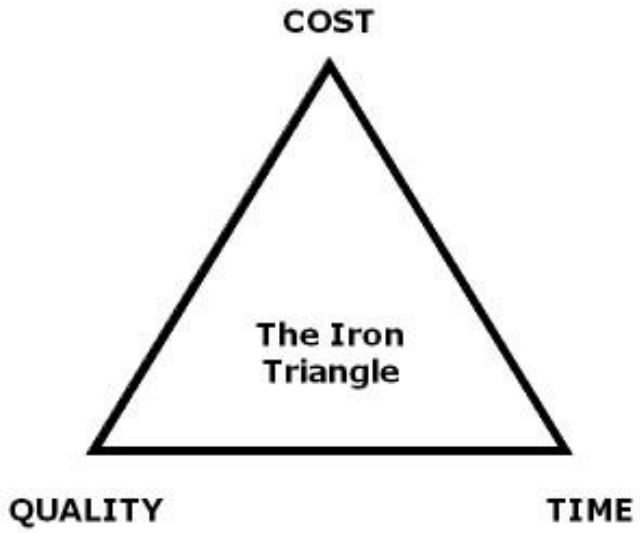

Figure 2. 1 The iron triangle (Source Ebbesen & Hope, 2013)

2.5. Critical Success Factors for construction projects

Measuring a project's success is not all about the completion of the project. Doubts often arise about what determines construction project success. In this regard, critical success factors are one of the determinants of the construction project's success. According to (Silva et al., 2015), there is no disputing the fact that understanding the concept of critical success factor is a vital tool for project managers in effectively managing projects and tracking progress made towards achieving project success. So, what are these success factors that are crucial to the success of a project? The concept of success factor for projects is not new and has existed since the 1960s. According to Asemi & Jazi (2010), it can be traced back to 1961,

when Daniel (1961)first discussed success factors in management literature. In a broad approach, Daniel, (1961) focused on industry-related success factors /relevant to any company in a particular industry. Gradually, the concept of critical success factor appears in management literature. According to Unegbu et al. (2020), critical success factors were introduced by Rubin and Seeling in 1976 for projects, but it was first used in project management by Rockart in 1982.

Critical success factors are the conditions that must be met for the project to succeed (Poon & Wagner, 2001). Similarly, critical success factors are conditions, circumstances, or events that surround a project which can influence project success (Ika, 2009). Generally, critical success factors can be defined as a means of a specified element that helps considerably to the success of the project and is a very important component of success. These factors have multiple effects on the success of the project. According to Sanvido et al. (1992b), critical success factors help to predict the success of the project. This is the reason different studies have shown different CSFs for the success of a project.

According to the description given above, critical success factors are attributes or conditions that require special attention from management because of their importance to the project's success. They can be internal or external, and mostly, they have a beneficial or positive impact. Critical success factors have distinguishing features that require exceptional attention or focus to avoid unpleasant output, missed chances, or objectives (Sanvido et al., 1992). However, numerous factors influence the success of a construction project, and people have a limited capacity for information processing, with the ability to remember only five to nine chunks of knowledge in short-term memory. Managers require the reduction of critical success factors from a few to a manageable number, which only includes factors most important for success (Cooper, 2008). Hence, it is important to study these factors and minimize their number.

2.5.1. Grouping of Critical Success Factors for Construction Projects

Until the first effort by Pinto & Slevin (1988) to classify success factors into different groups, success factors were not classified and the list of success factors was considered in one group which is a critical success factor. This became problematic since the majority, if not all, of these lists, including factors relating to the project manager and the company to which the project belongs, while ignoring project characteristics, team member characteristics, and external influences. For example, in construction projects, weather conditions are

circumstances outside the control of project managers or organizations; however, it might be a key element in completing the project on time (Belassi & Tukel, 2001). To address this issue, Belassi & Tukel (2001) stated that identifying the groups to which the critical factors belong would be sufficient for better project evaluation. Then project managers would clearly understand which aspects of projects might be critical for their successful completion. By doing that, factors belonging to a different group will have equal opportunity to of being considered critical.

There are different grouping for critical success factors. Chan et al. (2004) classify critical success factors into five major categories. These include human-related factors, project-related factors, project procedures, project management actions, and the external environment. Similarly, Gudienė et al. (2014) classified critical success factors as contractor-related factors, client-related factors, project manager-related factors, project management/ team-related factors, project-related factors, external factors, and institutional factors. Unlike the first classification, Gudienė et al. (2014) study classified human-related factors further into project manager, contractor, and client-related factors, which raised the number of groups from five to seven.

Most classifications are customary and reputedly used. However, there are also classifications that are not customary or not reputedly used. But, these classifications are sometimes used by researchers for their studies. These classifications are one or more specific groups that are used to cover specific topics. Belay's (2017) study classified success factors into six groups: management-related factors, project manager-related factors, client-related factors, contractor-related factors, environmental related factors, and purchasing-related factors. Similarly, Eyassu (2020a) and Saqib et al. (2008) studies categorized critical success factors into project management factors, environmental-related factors, client-related factors, project manager-related factors, design team-related factors, contractor-related factors, and procurement-related factors. From Belay (2017), Eyassu (2020a), and Saqib et al. (2008), two specific groups can be found. This is because, Belay (2017) wanted to relate the change in the criticality of success factors to product quality, manufacturing, and brand awareness in which the classification purchasing related factors was used. On the other hand, Eyassu (2020a) and Saqib et al. (2008) included the procurement-related group since the project delivery system was considered one of the major causes of project success or failure.

The process of grouping factors is dynamic, and there is no common classification. Most of the time, researchers have grouping depending on the section or topic in their studies they want to cover, and based on the considered problems, still there can be some classifications that can be found in a repeated number of researches. For example, the above-listed studies have three groupings that can be found in all of them and a total of six groupings that are not commonly found in the studies. This pattern of repetition was also seen by (Belay et al., 2021) and a total of six repeatedly used grouping or classifications were given in the study, they are:

- Project related factors
- Project management-related factors
- Contractor related factors
- External factors
- Consultant related factors
- Client related factors

2.5.2. Interrelationship Among Critical Success Factors

To discuss the interrelation of critical success factors, first, the grouping of critical factors must be considered. This is because the grouping of those factors is based on the relationship between them. But their relationship is not bound by just being in the same group. Success factors in a different group may have an interrelation and affect one another. This will lead to factors that often do not directly affect project outcomes critically becoming critical since they affect factors that are critical to the project. This was shown by Belassi & Tukel (2001) using multi-variable analysis. As per this study's findings, a project manager's performance (competency) on the job is affected by the factors related to the organization, especially top management support, the project manager's ability to implement a project, technological, economic, and social factors, and by factors related to the project such as its size, value, and urgency. This shows success factors, whether in different or the same group, have an interrelation with each other. Furthermore, less critical success factors, like social factors, affect more critical success factors, such as the project manager's competency.

Liu et al. (2016) claim that construction innovation's critical success factors have strong interrelationships. As this study findings, all the 19 success factors considered in the investigation have strong direct or indirect relationships. This interrelationship between success factors can be in two ways: one is to influence other factors, and the second is to be

influenced by other factors (Iyer & Sagheer, 2010). Out of the 19 success factors identified by Liu et al. (2016), four are the most influential success factors, including owners' judgment, external support, top management commitment, and strategic importance of innovation. Three success factors, including clear identification of user's needs, responsiveness to change, and proper strategies to transfer knowledge, are the success factors that are affected the most by other success factors.

Even though most of the success factors have a strong relationship, the type of relationship they have varies (Anoop et al., 2016). Success factors have either positive or negative relationships with each other (Rhodes et al., 2014). Chen et al. (2012) claimed that political-related success factors such as riots, revolution, and war have a negative effect on economically related factors like price fluctuation of labor and availability of material. Whereas factors related to consultant and client such as the experience of the client and consultant cooperation will positively affect contractor-related factors, like competency and ability of the contractor. A single success factor can affect either a single success factor or multiple success factors. On the other hand, multiple success factors could affect a single success factor or multiple success factors (Chen et al., 2012). Also, the extent of one factor's effect could change when it is combined with another factor. He, (2021) claimed that a project manager's leadership style affects an organization's project culture and effective communication, and when its effects are combined with economic viability, they affect the creativity of the project team. This is because the economic viability of the project affects the degree of freedom and conservativeness of the project manager's leadership style, which in turn influences creativity (Jung et al., 2003).

Generally, critical success factors, whether they belong to the same group or different groups, have a strong relationship. These relationships can be direct or indirect, positive or negative. The effect of one factor on the other factor varies when it is combined with another factor. So, when studies are conducted on critical success factors, the interrelationship among these critical success factors must be considered. This is because the most critical success factor is not independent and has dynamic relationships that will affect the result of studies conducted on them.

2.5.3. Importance of Identifying Critical Success Factors

Many studies have been done in different parts of the world on assessing, modeling, and identifying critical success factors. From this, one big question will arise: what is the purpose

or aim of those studies besides performing different analyzes on success factors? It can be said that those studies about critical success factors will enable special attention to be paid to those areas which could improve the performance project, but different scholars have given assorted reasons for their studies.

According to (Cooper, 2008), identifying and assessing critical success factors benefit projects by helping ensure critical areas required for the successfulness of projects are addressed effectively. This is done by focusing on a few factors that can affect the performance of the construction project operations. Similarly, Saqib et al. (2008) showed identification, analysis, and prioritization of critical success factors can be used as a forecasting technique to enable stakeholders to quickly estimate the project's potential for success. So, if a project participant can better forecast the likelihood of success, they can stop and avoid unsuccessful projects and instead focus on identifying promising projects worth pursuing, as well as identifying problems with present projects and taking corrective action.

Abraham (2004) also suggested that other than performing the project, identification of success factors also helps different companies involved in the construction industry. This is because, once those companies have identified those critical success factors, company executives would have a gauge by which they evaluate their company's performance. They would allow the executives to implement standard organizational management skills to improve company performance. The critical success factor will help the organization put its emphasis on such vital critical success factors by which it will structure its capabilities to meet the critical success factor. This will help the organization conduct self-check-in, which decides whether they have the competence to build the requirements essential to meet critical success factors or not. By doing this, such organizations double-check their level of competency and prepare for an update or future readiness.

2.6. Critical Success Factors for Construction Projects in Different Countries

2.6.1. Critical Success Factors for Construction Projects in Developing Countries

Critical success varies from one country to the other. But, there are some patterns of reputation or sense of similarity in countries with similar or closely separated development levels (Silva et al., 2015). This is because construction activities and their outputs are a crucial aspect of development (Anaman & Osei-Amponsah, 2007). Countries like Ethiopia,

Malaysia, and Qatar are all designated as developing countries by the World Bank but at different levels (Fantom & Serajuddin, 2016). These countries have almost similar critical success factor patterns with minor variations. This can be illustrated based on the research conducted in these developing countries. Based on the context of Ethiopia, which is the least developing country on the list, a study conducted by Belay (2017) shows that factors like decision-making effectiveness, project delivery system, timely decision-making by the owner, contractor cash flow, the leading skill of the project manager are the most critical success factor for construction projects, in which all except project delivery are human-related factor which shows that factors related to the ability of different stakeholder are crucial for the success of construction projects. Similarly, Belay et al. (2021b) using AHP also concluded clear and precise goals by the client, consultant's competency, consultant track record, cooperation of consultant in solving a problem, and contactor's financial situation, which are all human-related factors, are the most critical success factors.

With countries ranked from middle to top developing, which are Malaysia and Qatar respectively, the pattern is like Ethiopia. But, unlike Ethiopia, these countries also include factors related to the project besides human-related factors as the most critical ones. In this regard, Yong (2013) conducted a study from the Malaysian point of view and showed project financing as the second most critical factor next to contractors' capacity, followed by more human-related factors including team leader competency, consulting competency, proper site management, and commitment of stakeholders. This was further supported by the study conducted in Qatar. According to Gunduz's (2018) study, project-related factors such as proper planning of the project and scope and work definition of the project are the most critical success factor besides human-related factors like effective site management, contractors' capacity, and financial strength.

The critical success factors that are crucial for developing countries are mostly related to the human side of the project. Nevertheless, there are variations among them based on the level of their development. Based on that, the countries that are found in the last in the development level are mostly affected by human-related factors and as we go up, more and more project-related factors are critical besides the human-related critical success factors. This may be because of the lack of advancement in technologies that can simplify the burden on the professionals involved in the project and a lack of skilled and educated human resources.

2.6.2. Critical Success Factors for Construction Projects in Developed Countries

In the above section, it was observed that countries that have similarities in development level have similar or close to similar critical success factors for their construction project. Besides that, they have similar trends. As the countries became more and more went up the development ladder, they tended to have critical success factors other than human-related factors, which were seen in research (Belay, 2016; S. Belay et al., 2021b; Gunduz, 2018; Yong, 2013). This was also evident in developed countries in which countries with almost similar development have factors with similar trends.

Considering critical success factors for the construction project in developed countries, the factors critical to the construction project are not mostly human-related success factors; they are either external factors or factors related to the project. We can see this in a study by Li & Akintoye (2012) in the united kingdom. Their study shows procurement, project, and external issue-related factors as the most critical success factors. They further specify it by listing the top five critical success factors, which include the effectiveness of procurement, implementablity of the project, government guarantees, favorable economic condition, and availability of the financial market. From this, we can see that the factors critical to success include external environment-related factors. They are related to the aspects of the projects, including the economic, characteristic-based, and political surroundings.

Similarly, Lithuania is another developed European country with factors other than human-related factors as critical ones as the United Kingdom. In this regard, Gudienė et al. (2014) claimed that factors related to the project dominate the place for the most critical success factors. The study further clarifies these factors by providing the list which includes factors like a clear and realistic goal of the project, project value, planning of the project, projects complexity/uniqueness, and one human-related factor project managers experience as the top five critical success factors. This shows that factors related to the characteristics of the project are important and it has a similar pattern to the United Kingdom, in which both countries exposed factors other than human-related factors as the most critical factors.

Some researchers conducted critical success factor-related studies by comparing the case of developing countries with developing countries. The studies conducted in the context of developed countries mostly demonstrate critical success factors as project-related factors or external factors rather than human-related factors (Gudienė et al., 2014b; Li & Akintoye, 2012). On the other hand, developing countries demonstrate human-related factors as the

most critical ones (Belay et al., 2021b). This shows the success of construction projects in developing countries depends on certain capabilities or fulfillment of requirements that the personnel or professionals must have. These differences arise because of differences in development and this may be because of differences in the level of education and training coverage, availability of qualified professionals, availability of advanced technology, etc. when it is seen explicitly. This can be seen decreasing as we go from the least developing to the more developing to that of developed countries which may suggest with an increase in development which includes development in technology and education, the cruciality of human-related factors can be decreased or overcame and it will shift the focus away from human-related factors to other factors. Since there are differences in critical success factors between developed and developing countries context studies should be conducted in both cases separately.

2.7. Identification of Critical Success Factors for Construction Projects Using Different Methods

Studies conducted on critical success factors use different techniques. In this regard, Belay (2016), Gudienė et al. (2013), and Nguyen et al. (2004) used the Likert scale to conduct their studies. On the other hand, Belay et al. (2021b) and Gudienė et al. (2014) used AHP to conduct their studies. Based on these methods, the success factors found as critical tend to vary. This was observed in Gudienė et al., (2013) and Gudienė et al., (2014b) studies conducted in the same country using the Likert Scale and AHP methods, respectively. These researches have different outputs, even though the studies are conducted in the same country. In the first one, the study conducted using the Likert Scale method reveals the project manager's competency, coordinating skills, clear and precise goal, project value, and project manager effective and timely conflict resolution as critical factors. On the other hand, the study conducted using the AHP reveals clear and realistic goals, proper planning, project manager competency, relevant experience, and clear and realistic goal by the client as critical once.

The results show that the output will be different for studies conducted using different methods. This can be related to the effect of grouping discussed above, which indicate classifying and considering the effect of grouping in studying critical success factor will lead to factors other than project management to be considered or have equal opportunities to be selected (Belassi & Tukel, 2001). When we use methods that utilize the effect of the group,

the value tends to change. This is because multi-criteria decision-making tools like AHP consider the effect of grouping into consideration (Thakkar, 2021).

2.8. Critical Success Factors for Different Types of Construction Projects

There are many types of construction projects in the world. The classification of these projects varies from the scale of the construction projects to the function of the projects (Safa et al., 2015). Such type of classifications leads to variation in studies conducted on critical success factor for construction projects. The studies by Belay et al. (2021b), Gudienė et al. (2014), and Ling & Bui (2010) were conducted on critical success for construction projects, and also studies by Belay (2016) and Eyassu (2020b) were conducted on building and real estate construction projects, respectively. They conducted these studies on different types of projects based on their function. On the other hand, Mathar et al. (2019), Nguyen et al. (2004), and Zainal et al. (2019) conducted studies based on the scale of the project as large buildings, high-rise buildings, and large construction projects, respectively.

Critical success factors vary from one type of project to the other, which are classified by function or scale. There is a lack of consensus in identifying critical success factors for different construction projects (Davis, 2014). This could have been derived from the unique characters involved in different types of projects. This can be shown based on the studies by Belay (2016), Belay et al. (2021b), and Eyassu (2020b) conducted in Ethiopian construction perspective on building construction projects, construction industries, and real-estate projects, respectively. The first one is Belay, (2016) concluded that for the effectiveness and success of building a project, factor like the leadership skill of the project manager, the project's clear objective, and adequacy of the fund is critical. On the other hand, Belay et al. (2021b) study suggested that clear and precise goals by the owner, competency of the consultant, and the consultant's track record are the most important factor. The third one is Eyassu (2020b) study, which is conducted on real estate projects. According to the result of this study, the communication system, the timely decision by the owner, and project management competency are the most crucial factors.

Mostly for construction industries and building projects, having a clear objective is important. But, for the first, it is by the client in which the client has a clear view of what he wants or what he desires to achieve and the second one is of the project which is connected with the planning of the project and how the project is perceived by different stakeholders.

When we see the case for real estate, the competency of the project manager and the channel of communication between different stakeholders is crucial as also the decision-making effectiveness of the client. Similarly, for building projects, the competency of the project manager is important, but rather than its competency in general, the only specific trait is the effective leadership of the project manager. Besides that, the adequacy of the fund is crucial. From this, we can see that the two cases cover different factors which are specific to their respective cases. For the construction industries in general, the most important factors are related to the abilities and capabilities of the consultant, which cover broad project types and are given as collective factors for all cases.

The construction project also varies according to their scale. The range can span from small and medium to large scale. As the project scale varies, project-associated features also tend to vary with the increase in the scale of the project, the intensity of project monitoring, budget, and resource, and the project's complexity (Whitt, 2012). As this feature varies, the critical success factor for such projects also varies. This can be observed by comparing studies by Nguyen et al. (2004) and (Thi & Swierczek, 2010), conducted on large construction projects and normal construction projects, respectively. From these, it was observed that even though project management-related factors are critical in both cases, the number of project management-related factors at the top of the priority list varies, as large construction projects related to the study have more project management-related factors and the factors are project managers competency, adequacy of funding and competency of the project team. Whereas for normal construction projects, project manager competency, external stability, and project team competency are the most critical success factors.

Critical factors vary from specific projects to other projects and also to general cases. This was also shown by Silva et al. (2015) study, which concluded that there is a difference between the output of studies conducted on different types of projects, and most studies on critical success factors are too generic and pose a question of applicability in a project-specific industry such as construction. So, it is preferable to conduct studies specifically to find the appropriate and precise success factors.

2.9. High Rise Building Projects

When considering what a high-rise building is, different countries, even different states in the same countries, have different definitions. It looks like these countries define high-rise buildings according to their state of the economy and the number of multi-stories buildings

existing in the countries which are above a certain height. For example, when we consider the case of developed countries in this case, which includes the United Kingdom and Hong Kong (SAR) each considered a relatively higher number of the story or larger height than that of developing countries in this case India, Iran, and Nigeria. When seeing each definition explicitly, the United Kingdom definition states that a building can be high rise when it has 15 or more stories or when it has a height of over 45 meters (Oak, 2018). The definition of a high-rise building is a little exaggerated when considering the Hong Kong (SAR) definition. According to Anson et al.,(2002), buildings having a height of over 67 meters or 22 or more stories can be considered high-rise buildings in Hong Kong (SAR).

On the other hand, when the definition of developing countries for high-rise buildings is considered, the required number of stories or heights is relatively much smaller. According to the National Building Code of India (2005), any building with a story of more than five stories is considered a high-rise building. Similarly, in the case of the Nigerian city, Lagos State Urban and Regional Planning Development Law, a building with five stories or 12 meters in height can be called a high-rise building (Obinna, 2020). The definition of Iran, which state a building is considered high rise if it has more than 12 stories (Roggema & Roggema, 2020), is much higher but still small compared to the developed country's definition. From this, it is seen that the number of stories a building must have to be considered high-rise buildings in developing countries like Nigeria and India is almost half the minimum number of building stories considered to be high-rise buildings in developed nations.

In Ethiopia, there is a lack of either nationwide definition or city-specific definitions for high-rise buildings. But a zonal classification sets height limits for each zone without defining a high-rise building. They were elaborated as follows as given by (AACPPO, 2017):

- Building Height Zone 1: has a 70-meter minimum height and adds no limit on the maximum height.
- Building Height Zone 2: has a maximum building height of 70 meters.
- Building Height Zone 3: has maximum building height is 35m.
- Building Height Zone 4 has a maximum Building height is 35m, but the floor area ratio is different from zone 3.

Different countries, or even various pieces of legislation within one country, do not use a fixed height or a specific number of floors to define a high-rise building. Therefore, the

current study also adopts Iran's definition, which states that a building with 13 or more stories is a high-rise building (Roggema & Roggema, 2020) .

2.9.1. The Trend of High-Rise Building in Ethiopia

When we see the trend of high-rise buildings in Ethiopia, over 75 high-rise buildings are currently under construction and operational stages in Addis Ababa and more than 41 buildings are currently being built (Moche, 2021). This trend is only going to increase and more and more high-rise buildings are going to be built. According to the Addis Ababa City Administration Building Permit and Control Office, from the total of 647 building permits given from 2017 till now, over 95 buildings are high-rise buildings, which is more than the number of high-rise buildings currently under construction. Furthermore, with the scarcity and the increase in the cost of land, the number of high-rise buildings is going to increase and buildings are going to have more floors rather than more surface area. This was further supported by Gebremichael (2016), study, which indicated that Addis Ababa is going to be a jungle of high-rise building since high-rise solution has been adopted for both residential and commercial buildings.

2.10. Critical Success Factors for High Rise Building Projects

As stated, before CSFs can be defined as a means of a specified element that helps considerably to the success of the project and it is a very important component for success. Critical success factors for high-rise building construction projects are sometimes categorized under critical success factors for large construction projects or buildings in general in developed countries. Some studies explicitly studied high-rise building projects but these studies are limited in number and some of them are covered in detail below.

The first one is Nguyen et al. (2004) study on critical success factors for large construction projects, specifically high-rise building projects in Vietnam, to identify Vietnamese construction project success factors and uncover the underlying relationships between these factors. In this study, the researchers distributed 109 questionnaires and analyzed the result using the relative importance index by using the Likert scale and Factor Analysis methods and found out that the top five critical success factor that affects large construction projects in Vietnam are having competent project manager and adequate funding until project completion, multidisciplinary/competent project team, commitment to project and availability of resources. They further concluded that most of the critical success factors are human-related factors which imply that people play a decisive role in the success or failure

of a project, which is not surprising since they are responsible for creating, managing, operating, and using the project and are invariably affected by it.

Another study was conducted to identify critical success factors for large building construction projects in Saudi Arabia by Mathar et al.,(2019). This study analyzed 61 questioner's returned based on a descriptive quantitative approach using the Relative importance index and identified the competency and capability of the contractor's key personnel in different disciplines, project manager's competency, authority and involvement, clear communication channels between the owner/project managers and the designer, clear communication channels between the project manager and the contractor, commitment of all project participants to the established schedule and budget, good coordination between project participants as the top seven critical success factors. They also determined that identifying the most crucial success element will help construction stakeholders properly deploy finite resources toward completing a successful project.

Furthermore, Bhangale, (2016) studied 75 critical success factors for high-rise buildings in India to evaluate and rank the critical success factors influencing the performance of construction projects. This study was conducted using a descriptive quantitative approach by applying a relative importance index on a Likert scale basis. This study's findings exposed average delay because of closures and materials shortage, availability of personnel with high experience and qualification, belonging to work, learning from best practices and experience of others, economic environment, cash flow of the project, and availability of resources as planned throughout the project as the top six critical success factors. This study concluded that the factors associated with quality and client satisfaction are rated at significantly lower positions, and it can be summarized that various factors are responsible for the successful completion of a construction project, which must be considered when developing a proper performance measurement system. And it was also suggested that by recognizing the link between all of these essential aspects, appropriate modifications be made in the company's working strategy to attain a higher degree of success with improved project performance.

From the above-reviewed studies, it is seen that three common factors were present in all the studies as the top 5 most critical success factors were competency of the project manager, adequate funds or resources, and proper planning of its flow. This factor may be related to the difficulty of these projects since high-rising building projects as part of large construction projects require a high number of workers, intensive use of the equipment, and too many

resources. This requires proper coordination and funds to keep up with the continuity and the flow of the construction project which is coordinated and led by the project manager.

2.11. Literature Summary and Research Gap

A construction project can simply be defined as a process of creating a construction facility of service to fulfill the predetermined objective. This objective can be set by different stakeholders involved. Unlike other projects, construction projects have high risk, high cost, a large number of workers, high complexity, and require multiple disciplines. These projects are part of a large industry, which is the construction industry. This industry involves activities ranging from the production of raw materials and designing to conducting physical work. The construction industry is a very important industry for the development of a country. As it creates employment and also covers most of the industrial output of countries like Ethiopia. But the industry is complex and prone to failure. So, making it successful requires special attention.

Even though there is no industry-accepted definition for construction success, it can be defined as a degree of perception to which the predetermined objectives are met. These objectives are measured according to different criteria. These criteria can be either efficiency-based or effectiveness-based and include cost, time, user satisfaction, profitability, safety, etc. Out of these criteria, the three basic criteria are time, cost, and quality. These basic criteria are very important, and the current research will also be focusing primarily on them. Setting these criteria will help avoid confusion and also set a reference to measure success.

One of the determinants of construction project success is special attributes called critical success factors. Critical success factors are circumstances or conditions that influence the output of the project. So, special attention should be paid to them. There are numerous studies conducted on critical success factors for construction projects (Belay, 2016; Belay et al., 2021b; Nguyen et al., 2004; Eyassu, 2020a; Gudienė et al., 2014a; Bhangale, 2016). These studies are conducted to identify, assess, prioritize, and also model success factors. This is done because understanding the success factors is useful to increase the success rate by predicting the project's success, assessing the company’s performance, and identifying and paying special attention to a few critical factors. When such studies are conducted, success factors are grouped into different categories. By providing a grouping, the prioritization of factors is facilitated by first ordering categories according to their

significance followed by the prioritization of critical success factors, which will give all the success factors are given an equal chance of being selected as critical. This is done to increase the accuracy of the study's results. The classification of this factor is based on the relationship they have. But relations are not just bounded by a group; success factors in different groups may have an interrelation. The relation between can be either positive or negative, and also less critical success factors may influence the most critical ones and vice versa. So, the interrelation between success factors must be viewed in detail when conducting a study on success factors.

The list and prioritization of success factors tend to vary from one study to the other. This variation usually occurs when there is a difference in the area of study, method of study, and the type of project in consideration. The review of past studies (Belay, 2016; S. Belay et al., 2021b; Gudienė et al., 2014a; Gunduz, 2018; Li & Akintoye, 2012; Yong, 2013) exposed the difference in critical success factors with change in the study area. On the other hand, (Gudienė et al., 2013, 2014a) showed a difference in critical success factors because of variation in the methods used by the respective studies. Furthermore, studies (Belay, 2016; Belay et al., 2021b; Eyassu, 2020b) showed a difference in critical success factors due to variations in project types.

Since critical success factors vary with the variation in the type of projects, so, studies have to be conducted according to unique features shared by a group of projects (project category) that affect their critical success factors. One such project is a high-rise building project. A High-rise building can be defined as any building that has 13 or more stories. Previously, some studies (Nguyen et al., 2004; Mathar et al., 2019; Bhangale, 2016; Zainal et al., 2019) have been conducted to identify high-rise building-related critical success factors. Throughout all of those studies, the main objective was to identify success factors and assess and prioritize those factors to pay more attention to the most critical factor and to help decision-makers allocate more resources to such factors to make the project successful. From these studies, the list of common factors is generalized and given in Table 2.1. And also, the following major gaps were observed.

- first, there is a lack of research done on critical success factors that consider the influence of one factor on the other factor besides from there importance to success. This is necessary because critical success factors are not independent, and less important factors may influence more important factors.

- The second one is there is a lack of studies conducted on critical success factors for high-rise buildings in Addis Ababa or generally in Ethiopia.
- Third, there is a gap in using appropriate methods. As critical success factor has different grouping and classification, a proper method of analysis such as multi-criteria analysis methods must be used. but there is a lack of studies conducted in Ethiopia on building construction project and especially in high-rise building projects which uses such methods.

Table 2. 1 List of identified success factors from the literature review

	Goal	Categories	Critical success factor	S. Belay, (2021b)	Nguyen et al., (2004)	Gudienė et al.,(2014)	Mathar et al., (2019)	Bjeirmi. et al., (1996)	Abraham, (2004)	Saqib et al., (2008)	Eyassu, (2020a)	Chen et al., (2012)	Pankaj, (2016)	(Kog & Loh, 2012))	No of Repetition
1	Success	Project related factors	• Adequate funds/resources	√	√	√	√								4
2			• Size of project	√		√	√								3
3			• Type of the project	√		√					√	√			4
4			• The complexity of the project	√		√					√	√			4
5			• Adequacy of fund		√	√	√					√			4
6			• Innovations			√									1
7		Project management-related factors	• PM competency,	√		√								√	3
8			• PM authority and involvement	√		√								√	3
9			• Relevant experience project manager			√			√					√	3

10	Success		• Decision-making effectiveness of the project manager			√			√					√	3
11			• Good communication between project management and its team			√	√						√		3
12			• Adequacy of the planning and control techniques				√	√						√	3
13			• Motivating skills			√									1
14		External factors	• Technological environment			√	√			√			√		4
15			• Availability of skilled labor			√	√			√			√		4
16			• Social environment	√		√						√	√		4
17			• Economic environment	√		√						√	√		4
18			• Political environment	√		√						√	√		4
19		Contractor related factors	• Site organization and proper crew formation			√	√								2
20			• Contractor's experience with similar projects			√	√				√	√			4

21	Success		• Contractor's technique and equipment advancement				√					√		√	3
22			• The economic and financial situation of the contractor			√						√		√	3
23			• Competency of the contractors'		√	√	√								3
24			• The capability of the contractors'		√	√	√								3
25			• The ability of contractor's employees									√			1
26			• Communication mechanism									√			1
27		Client related factors	• Size of the client.			√	√				√				3
28			• Experience of the client.			√				√				√	3
29			• Clear and precise goals or objectives.		√	√								√	3
30			• Moderate change orders.	√		√									2
31			• Type (private vs. public) client.			√	√				√				3
32	Success		• Ability to participate in different phases of project.			√									1

33			• Client's preference for risk sharing.									√			1
34		Consultant related factors	• Company characteristics.			√								√	2
35			• Experience of the consultant.	√						√				√	3
36			• Competency of the consultant.	√					√			√			3
37			• Consultant track record.	√	√									√	3
38			• Adequate plan and specification.		√	√							√		3
39			• Consultants' management capability.				√					√			2
40			• Construction documents management.				√								1

CHAPTER THREE
METHODOLOGY

3.1. Introduction

The role of methodology is to carry out research work scientifically and validly. This chapter includes the method used in this thesis work and provides information about the research approach, target population, sample size, research method, questionnaire design, questionnaire content, and tests the consistency of the questionnaire during data analysis.

3.2. Study Area

The study area of this thesis was Addis Ababa. Addis Ababa is the capital city of Ethiopia and has 11 sub-cities, as given in Figure 3.1. Addis Ababa, as it is the capital city, is home to different infrastructure projects, housing projects, real estate projects, and commercial building projects. It is also home to most of the high-rise buildings in Ethiopia and is currently under construction progress. This study focuses on critical success factors for high-rise building construction projects in the city of Addis Ababa, which are currently in progress that are near to completion or over 75 percent completed. This is because most of the high-rise building projects in Ethiopia are in its capital, Addis Ababa (Moche, 2021).

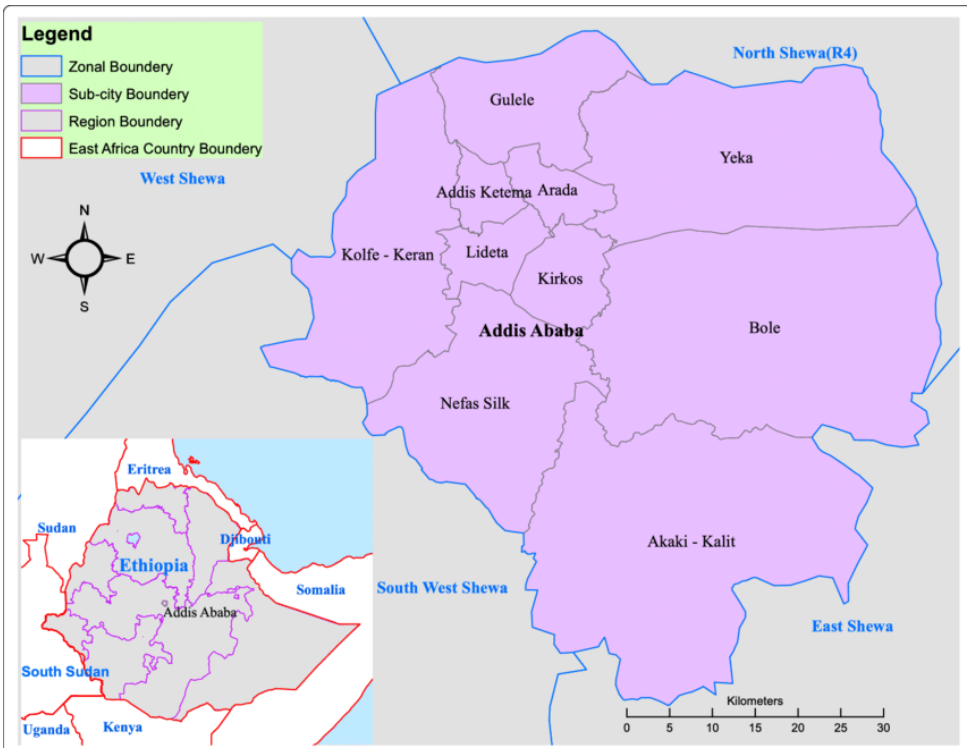

Figure 3. 1 Map of Addis Ababa (source Hassen et al., 2018)

3.3. Study Design

The study is both qualitative and quantitative with a descriptive nature following comparative judgment and expert judgment aimed at developing a hierarchical structure for critical success factors in high-rise building construction projects. For this study, Analytical Hierarchy Process (AHP) and Interpretative Structural Modeling (ISM) were used together in an integrated method. The AHP was used to accurately weight each success factor and assess its relative relevance, while the ISM was used to intuitively describe the interrelationships between them. To integrate the two methods, Quadrant Analysis was applied, and to know the extent of the relation between the two outputs, Spearman's Rank Correlation was used. To achieve the study objective, both primary and secondary data were used. For primary data collection, an AHP and ISM-based questionnaire helped structure the critical success factors hierarchy by first comparing success factors and second by finding out the influence of one factor on the other. Expert Choice was used for the computation of the AHP and while ISM software was used for the computation of the interrelationship part. The flow of work for the research is shown in Figure 3.2. As given in the Figure, the current study starts from the left, the AHP part, and then moves to the right, which is the ISM part.

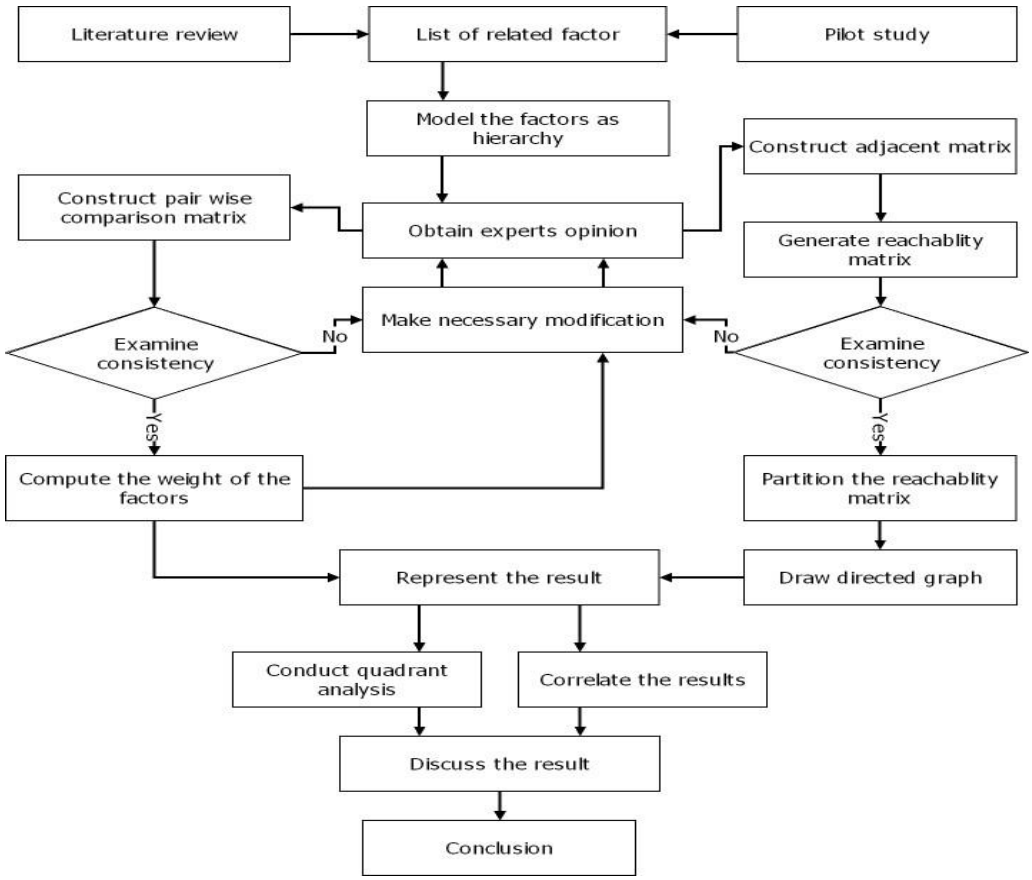

Figure 3. 2 workflows for integrated AHP (left) and ISM method (right)

3.4. Population and Sampling Technique

3.4.1. Target Population

The population of this study was high-rise building projects that are currently being built in the city of Addis Ababa. According to Addis Ababa City Administration Building Permit and Control Office, there are 41 high-rise buildings currently being built. From these projects, their construction manager, project manager, and engineers (both site and office) were targeted for the filling of the questionaries. These positions were selected because of their proximity to the execution of the project. Since they deal with various project stakeholders and often get involved in sensitive decision-making and dispute resolution processes and participate in the construction process (Toor & Ofori, 2008). Also, these professionals, which can be included as contractor consultants and project managers, have an almost similar perception of construction success and success factors (Belay et al., 2021b; Gunduz & Almuajebh, 2020).

3.4.2. Sampling technique

For this research, the type of sampling used was purposive sampling. This type of sampling is a technique which is non-probabilistic sampling technique and a sample from the total population is selected based on the judgment of the researcher. To improve the quality of research design, it is suggested that the selection of cases consider appropriateness and adequacy requirements, particularly in multiple case designs; while appropriateness is concerned with demonstrating a fit to both the purpose of research and the phenomenon of inquiry, adequacy is concerned with how much is sufficient (Kuzel, 1999). The most popular way for achieving the appropriateness criterion for case selection using pre-determined criteria is a purposeful sampling strategy. For this study, out of the total of 41 high-rise building projects, all 19 projects which are over 75% completed and currently active were selected. This was done because of two main reasons. The first one was to find projects that have enough progress to know whether they are successful or not. Since every project has a period after the middle point during which activities move the project toward completion either successfully or unsuccessfully (Barron et al., 2012; Darnall & Preston, 2010). The second one is because of its convenience for data collection, in which it is difficult to collect data from inactive sites. Furthermore, by taking these 19 projects which are 46.34% of the population, the sample fulfills the minimum required 30% for purposive sampling, which was recommended by (Felix, 2018; Mugenda & Mugenda, 2003; Ogeno, 2016). From this

project, all the available 73 professionals, which include construction managers, project managers, and site and office engineers, were selected as respondents.

3.5. Source of Data

The current study used both primary and secondary data sources to gather information about this area of research. Primary data was got from contractors, consultants, or project managers who are selected from the construction projects based on experience. Secondary data was collected and assembled by referring to different materials, which include books, articles, journals, conference papers, different websites, etc.

3.6. Method of Data Collection

3.6.1. Pilot Study

A total of 40 factors were collected from the literature reviewed as given in Table 2.1. From these, 35 factors were identified by selecting the factors with three or more hits on the literature reviewed. After the selection of 35 out of 40 factors three Ethiopian construction professionals including two engineers who have been working in the industry for over 16 years reviewed, the draft questionnaire for appropriateness in the Ethiopian construction industry for high rising buildings. Based on their feedback, the number of CSFs was reduced from 35 to 31. Then the short-listed 31 CSFs were then grouped into six categories: external factors, project-related factors, project manager-related factors, client-related factors, contractor-related, and consultant-related factors as shown in Figure 3.3. The number of experts used for the pilot study was considered enough since (Kar & Jha, 2020; Olawumi et al., 2018; Zavadskas et al., 2010; Zhu & Chua, 2018) used a similar number of experts to conduct pilot studies.

3.6.2. Questionaries

The primary tool of data collection for this study was by using questionnaires. The questionnaire was used for data collection because it offers considerable advantages in the administration, in which it can be distributed to large groups of people simultaneously and provides respondents the freedom to express their views or opinion candidly. The questionaries were distributed by hand and all the questionaries were filled by professionals working on high-rise building projects, including construction managers, project managers, and site and office engineers.

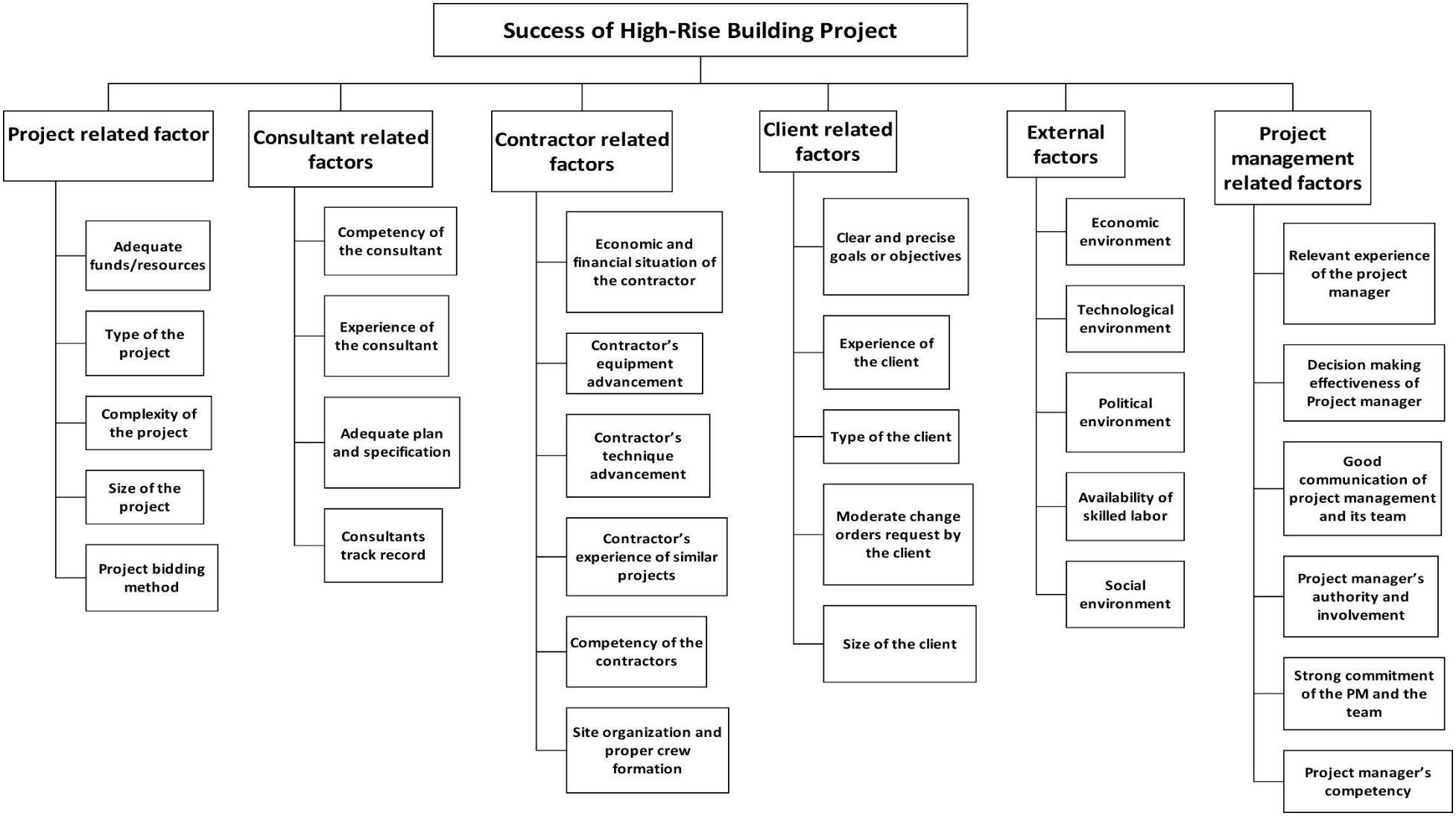

Figure 3. 3 Analytical hierarchical structure

In the first stage, a questionnaire was designed to facilitate the collection of pairwise comparison data in AHP. They were based on the literature reviewed and a pilot study conducted to get information on the success factors perceived by participants in high-rise building projects in Addis Ababa. The questionnaire survey dealt with success factors regarding high-rise building projects. Each CSF was to be assessed on a nine-point AHP scale, as the sample is given in Appendix E. The questionnaire survey was performed by distributing it to all 73 respondents and collecting it by hand (in person).

After the completion of the analysis of the first stage, the second round of questionaries was developed from the result of the first stage analysis. Out of the 31 critical factors analyzed in the first stage 21 critical success factors were selected based on their relative weight according to the weight found through the AHP analysis and questionnaires for the second stage, which is ISM analysis, were prepared and distributed to 63 respondent who successfully filled and returned questionaries in the first stage and was collected. The reduction of factors from 31 to 21 is done because the entire purpose of researching success factors is for the reduction of critical success factors to a few manageable numbers, which only include factors most critical for success (Cooper, 2008). Also, most researches that use an integrated method of ISM and AHP (Geng et al., 2018; Liu et al., 2015; Rimantho & Ardinia, 2020; Song et al., 2017) reduce the number of success factors between the range of 17 and 21 using different techniques before the analysis. Furthermore, these 21 factors selected for ISM analysis of the current study cover almost 90% of the importance weight from the AHP analysis, which means the list includes most of the factors, which are critical to the success of the projects. The sample questionnaires are given in Appendix D.

3.7. Method of Data Analysis

For this study, four types of data analysis techniques were used. The first one is AHP, which is a multi-criteria decision-making method that was used to rank the success factors based on their importance. The second one was ISM, which is also a multi-criteria decision-making method that ranks and structures the critical success factors based on their influence. The third one was spearman's correlation, which was done to know the level of relation between the prioritization based on importance and influence. At last, by combining the two, the data collected was processed and gives a structure that ranks these factors based on their importance and influence which was conducted using quadrant analysis.

3.7.1. Analytic Hierarchy Process

The construction complexity is rapidly growing, and making the best decisions becomes an increasingly demanding task for the stakeholders involved. Decision-makers do not use gut feeling to decide, but use analytic and quantitative tools, and base and analyze their decisions on solid ground. Many methods with applied mathematics background and operations have proved useful to help decision-makers make informed decisions and AHP is one of them.

The Analytic Hierarchy Process (AHP) is a basic approach to decision-making. It is designed to cope with both the rational and the intuitive to select the best from several alternatives evaluated concerning several criteria. In this process, the decision-maker carries out simple pair-wise comparison judgments which are then used to develop overall priorities for ranking the alternatives (Saaty & Vargas, 2012). According to (Brunelli, 2015), AHP is a theory and method for relative measurement. In relative measurement, we are not interested in the exact measurement of some quantities, but the proportions between them. Decisions can be made using weights based on subjective pair-wise relative comparisons using multilayer hierarchic structures when employing AHP. AHP is a method for solving multi-criteria decision issues and avoiding inconsistencies in decision-making.

3.7.2. Steps in AHP

The AHP allows for the problem to be decomposed into a hierarchy of subproblems that may be more easily understood and subjectively evaluated. The subjective evaluations are transformed into numerical values, then used to rate each alternative on a numerical scale. The step for this method is given as follows (Bhushan & Rai, 2014).

Step 1: The problem is broken down into a hierarchy of goals, criteria, sub-criteria, and options. This is the most innovative and crucial aspect of decision-making. Then the decision problem is structured as a hierarchy. The term “hierarchy” refers to the relationship between elements on one level and those on the level below it. This relationship percolates down to the lowest levels of the hierarchy, and every element is thus connected to every other element, at least indirectly. A sample of such a structure is given in figure 3.4.

Step 2: Obtain data from experts or decision-makers in the pairwise comparison of options on a qualitative scale, as explained below. Experts classified the comparison as equal, somewhat strong, strong, very strong, or extremely strong. As shown in Table 3.1, the opinions are collected in a specially prepared format.

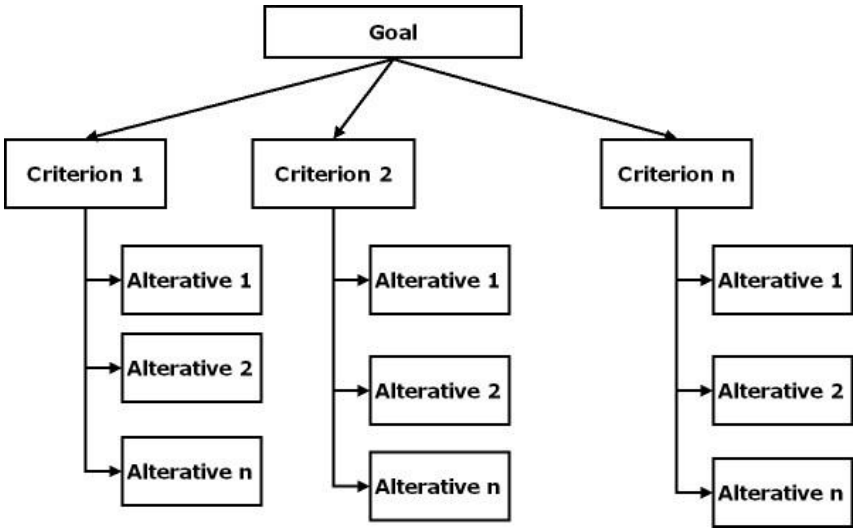

Figure 3. 4 Typical hierarchy structure of AHP

Step 3: A square matrix is created from the pair-wise comparisons of various criteria generated in step 2. The matrix's diagonal entries are 1. If the value of the element (i,j) is greater than 1, the criterion in the i^{th} row is better than the criterion in the j^{th} column; otherwise, the criterion in the j^{th} column is better than the i^{th} row. The reciprocal of the (i,j) element is the (j,i) element of the matrix.

Table 3. 1 Scale of preference in AHP

Intensity of Importance	**Definition**	**Explanation**
1	Equally	Two factors contribute equally to the objective
3	Moderately	Experience and judgment slightly favor one factor over the other
5	Strictly	Experience and judgment strongly favor one activity over the other
7	Very strictly	Experience and judgment very strongly favor one over the other
9	Extremely	The evidence favoring one over another is of the highest possible order of affirmation

Step 4: The comparison matrix's principal eigenvalue and related normalized right eigenvector show the relative relevance of the various criteria under consideration are created. Weights for criterion or sub-criteria and ratings for alternatives are the elements of the normalized eigenvector.

Step 5: The consistency of the n-dimensional matrix is assessed. The AHP tolerates inconsistency through the degree of redundancy in the technique, which allows for subjective comparisons. If the consistency index falls below a certain threshold, the results of comparisons may be re-examined. The CI (consistency index) is calculated as follows:

$$CI = (\lambda_{max} - n)/ (n - 1) \text{ ……. Equation 3.1}$$

In which λ_{max} is the maximum eigenvalue of the judgment matrix. This CI is comparable to the RI of a random matrix. The consistency ratio, CR, is the resultant ratio,

$$CR = CI/RI\text{……. Equation 3.2}$$

The value of CR, according to Saaty, should be less than 0.1 (Rajesh, 2020). And this part is covered in detail in the last section of this chapter.

Step 6: Each alternative's rating is multiplied by the weights of the sub-criteria and then aggregated to get local ratings for each criterion. The weights of the criteria are then multiplied by the local ratings to produce global ratings.

3.7.3. Interpretive Structural Modeling

The ISM approach for solving complex systems was first proposed by Warfield in 1973. It is an interactive learning process in which a set of unique, interrelated variables are structured into a comprehensive systemic model presented as a hierarchy graph. ISM provides a means by which people can synthesize an objective hierarchy of the factors by mathematical deduction, given the pair-wise relations among the factors (Gao & Yang, 2013). The basic idea of this approach is to use experts' practical experience and knowledge to decompose a complicated system into several simple subsystems and construct a multilevel structural model (Liu et al., 2015).

By using the output after the completion of ISM analysis, the factors are further grouped using MICMAC analysis. MICMAC analysis method explores influence and inter-dependency between CSFs. This method also classifies them into separate clusters by analyzing the driver power and dependence power of each CSF (Mandal & Deshmukh, 1994). ISM along with MICMAC analysis provides a useful hierarchy of factors whose individual relationships are unambiguous but whose group relationships are too complex to organize intuitively and can help practitioners better understand factor dependencies and prioritize those factors.

3.7.4. Steps in ISM

Given the pairwise relationships between the factors, ISM provides a method for researchers to synthesize an objective hierarchy of the factors through mathematical deduction. The following steps describe the overall process of ISM development as given by (Liu et al., 2015; Song et al., 2017)

Step 1: Determine the success factors set. A set of variables affecting success is defined. The relevant parameters to be considered in the analysis are developed by using different research tools

Step 2: Compare all the items pair-wise to establish directed relationships between them based on expert perceptions and build an Adjacent Matrix. The relationship is chosen based on "leads to" contextual relation. under the following rule.

If factor E_i influence/leads to factor E_j, then $E_{ij=}1$

If factor E_i not influence/leads to factor E_j, then $E_{ij=}0$

Step 3: Generate the reachability matrix. According to the transition law characteristics. It means if E1 can reach E2 through the access of one-unit length, meanwhile, E2 can reach E3 through the one-unit-length passage, then E1 could reach E3 through passaging two units' length instead (Azevedo et al., 2013)

Step 4: Partition the reachability matrix and construct a multilevel structural model. This is done by considering factors having all the row relation subsets of their column relation as the level they were considered. Besides that, the number of relations must be higher than the next factor

Step 5: Develop a graph that is directed. A digraph depicts the hierarchical relationships among these variables in terms of nodes and edge lines. The highest-level factor is the top-level factor at the top of the hierarchy, while the second-level factor is slightly below the top level. This procedure is known as repeat until the bottom level factors are at the bottom of the hierarchy.

Step 6: Conduct MICMAC analysis using dependency and driver power of elements in the reachability matrix as coordinates.

3.7.5. Spearman's Rank Correlation

The correlation of ranks introduced by Spearman is one of the oldest and best-known nonparametric procedures (Zar, 1972). Spearman correlation coefficient is used to measure the degree of relation between ranks (Szmidt & Kacprzyk, 2010). The formula to calculate

the coefficient of correlation is given in equation 4 as given by (Wiki, 1988)

$$r_s = \frac{1-6\Sigma\, d_i^2}{n(n^2-1)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{Equation 3.4}$$

Where:

$d_i = R(xi) - R(y)_i$, is the difference between the two ranks of each observation,

n = the number of observations.

The standard range of spearman's correlation spans from- 1, a complete disagreement to +1, a complete agreement even though the minimum value is zero. The degree of relation increase from 0 to -1 or +1 (Griffiths, 1980). In the current study, this method was used to measure the degree of relation between prioritizations based on importance and influence.

3.7.6. Quadrant Analysis

Quadrant analysis defines four quadrants of management actions resulting from a 2×2 combination of influence and importance mean ratings obtained from respondents. These quadrants are a priority for improvement (low influence, high importance), keep up the good work (high influence, high importance), possible overkill (high influence, low importance), and low priority (low influence, low importance) (Wibowo & Alfen, 2014). Since quadrant analysis is data-centered, the positioning of the vertical and horizontal axis is based on the grand mean of importance and influence (Bacon, 2003; Taplin, 2012). This method was applied for the current study to combine the prioritizations based on influence and importance and identify factors that are both important and influential.

3.8. Data Validity and Reliability

The accuracy and consistency of the survey are significant aspects of the research methodology Which are known as the validity and reliability of data. For this study, a validity measure was conducted by having experts who understand the topic go through the questionnaire to evaluate the content, and based on their evaluation and comment, the questionnaire is modified. On the other hand, to check if the questionnaires are filled correctly, the data were collected and checked for their reliability by consistency ratio. So, the reliability of data will be checked by calculating of consistency ratio, which is one component of the AHP method and it was calculated using AHP. Similarly, for the ISM part, the consistency of data will be checked using the CI ratio integrated into the software.

The computation for checking the consistency of the data collected is incorporated with the

method, which is AHP. The consistency is calculated using equation 3.1. And λ_{max} represents the maximum Eigenvalue and n is the matrix size. The consistency ratio is calculated using equation 3.2. To calculate this, the RI value is taken from the standard table (Table 3.2) developed by Saaty and it is given below:

Table 3. 2 Random consistency index value

N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.4	1.45	1.49	1.52	1.54	1.56	1.58	1.59

After the computation of the Consistency ratio, it is compared with the standard ratio, which is 0.1 and if is less or equal to it, the study will continue and if not, rechecking is required (Rajesh, 2020; Yin et al., 2011). On the other hand, for ISM analysis, the data collected must be at least 70% consistent (Alawamleh & Popplewell, 2011). Furthermore, the data for ISM analysis was further checked using Cronbach alpha for consistency, in which coefficients greater than 0.7 are acceptable (Levett-Jones et al., 2011).

CHAPTER FOUR

RESULT AND DISCUSSION

4.1. Introduction

This chapter discusses the result and interpretation of the analysis. This chapter mainly has four components. The first part includes the demographic distribution of the respondent based on education level, place in the organization, and experiences. The second part covers the result and interpretation of the AHP analysis, and the third part discusses the output of the ISM analysis. The last one of all covers the interpretation based on the combination or integration of AHP and ISM analysis.

4.2. Respondent Profile

4.2.1. Respondent Profile for Frist Stage

The questionnaire was designed and distributed to respondents in two stages. In the first stage, the questionnaires for AHP were distributed. After that, the questionnaire for ISM was distributed and collected. In the first stage, 73 questionnaires were distributed and 65 questionnaires were returned. Out of the 65 questionnaires collected, only 63 questionnaires were correctly filled and the other two were not completed. The details regarding respondent information are given in Table 4.1 below.

Table 4. 1 Respondent Distribution for First Stage

	Total Questionnaires	Successfully Returned	Not Responded	Incomplete
Construction Engineer	6	5	1	0
Project manager	14	13	1	0
Office Engineer	24	21	2	1
Site Engineer	29	24	4	1
Total	**73**	**63**	**8**	**2**
Percentage (%)	**100**	**86.30**	**10.96**	**2.74**

Most of the respondents who took part in filling the questionnaires have a bachelor's degree and a few others have master's degrees. Out of the 63 respondents who took part in filling the questionnaires, 11.11% of the respondent are master's degree holders. The rest 88.89%

are Bachelor's degree graduates. The details regarding the respondent's educational background are given in Figure 4.1.

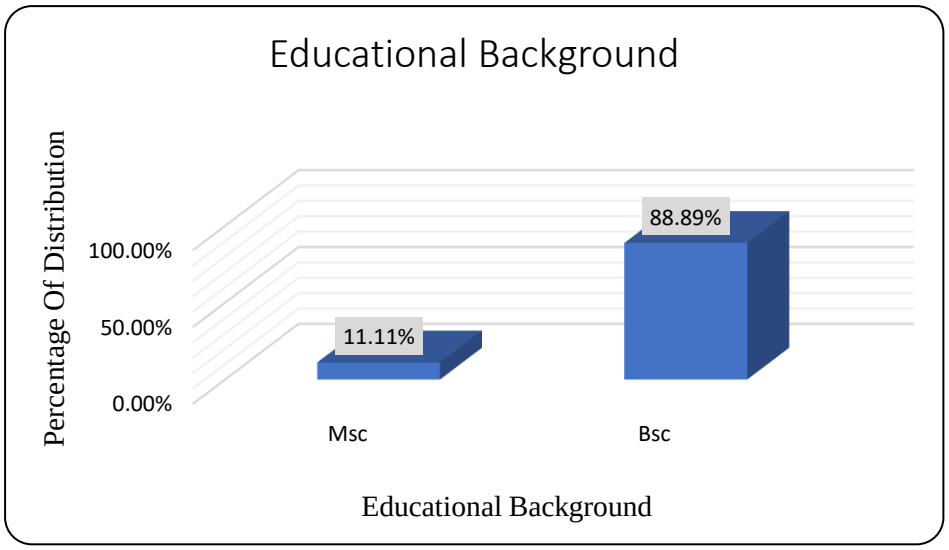

Figure 4. 1 Educational Background of The Respondent

The experience of this respondent varies from 1 to 5 years to over 20 years. Out of the total, 39.68% have experience ranging from 1 to 5 years. On the contrary, 1.59% have over 20 years of experience. The details regarding respondent the experience of the respondents is given in Figure 4.2.

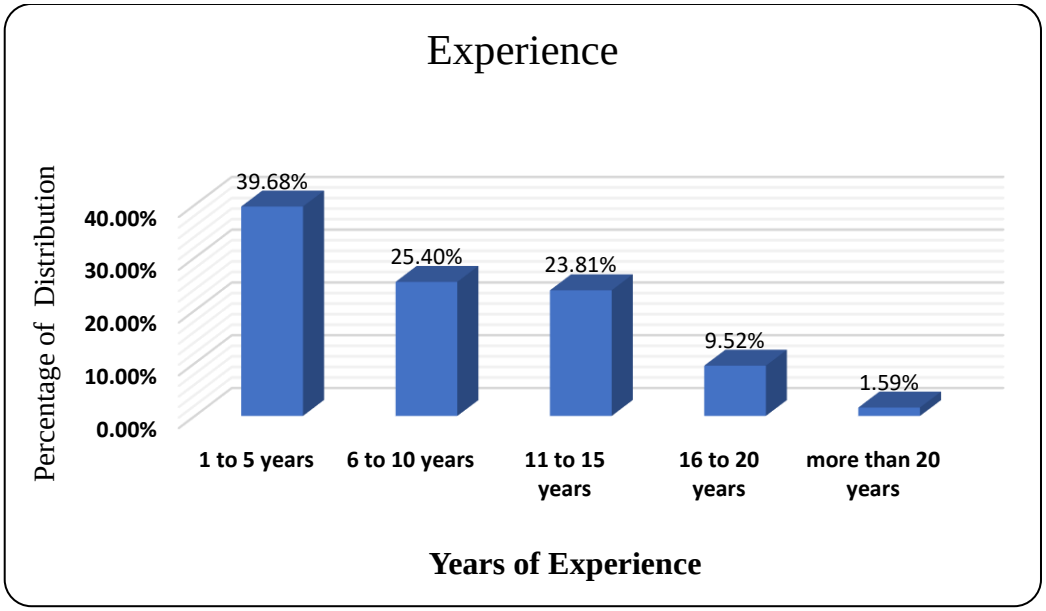

Figure 4. 2 experience of the respondents

4.2.2. Respondent Profile for Second Stage

After the completion of the first stage, the second stage, questionnaires based on ISM, was distributed and collected. A total of 63 questionnaires were distributed to participants who

responded in the first stage. Out of those, a total of 54 questionnaires were returned. Of the collected questionnaires, 3 were incomplete. The details regarding stage two respondent information are given in Table 4.2 below.

Table 4. 2 Respondent Distribution For Second Stage

	Total questionnaires	Successfully returned	Not responded	Incomplete
Construction engineer	5	4	1	0
Project manager	11	10	1	0
Office engineer	21	17	3	1
Site engineer	26	20	4	2
Total	**63**	**51**	**9**	**3**
Percentage (%)	**100**	**80.95**	**14.29**	**4.76**

Similar to the first stage, most of the respondents had a BSc degree, even though some had MSc. Out of the total, 7.84% were MSc degree holders. The rest had a BSc degree. And the detailed data regarding the respondent's educational background is given in the figure below.

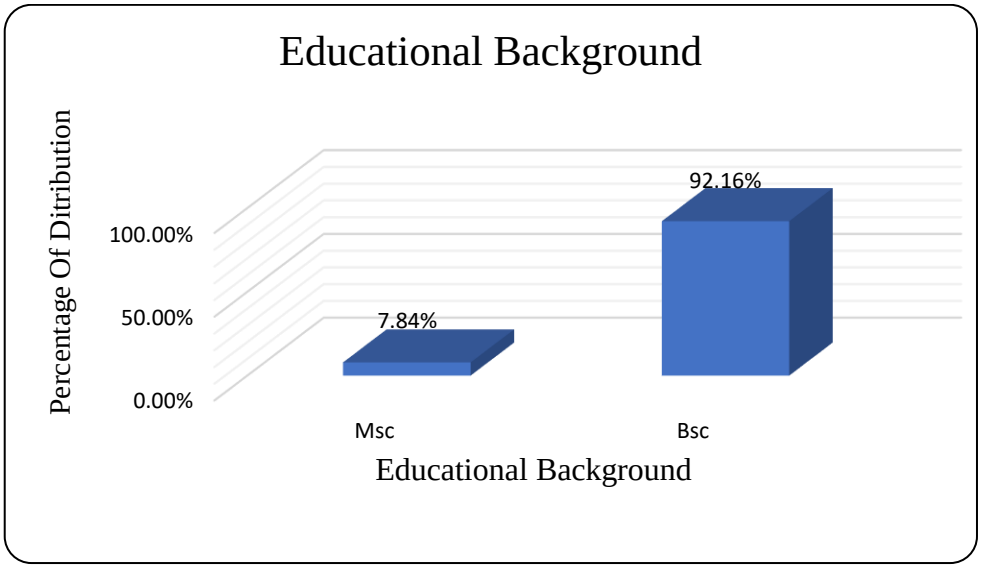

Figure 4. 3 Educational background of the respondent

The experience of this respondent varies from 1 to 5 years to 16 to 20 years. Out of the total, 41.18% have experience ranging from 1 to 5 years. On the contrary, 5.88% have 16 to 20 years of experience. The details regarding the experience of the respondents are given in figure 4.4.

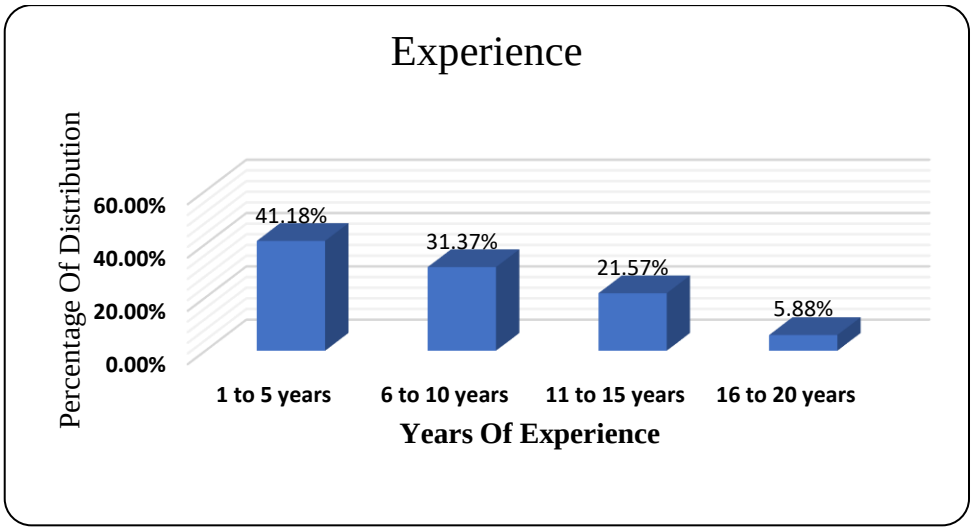

Figure 4. 4 Experience of the respondent

4.3. Prioritization of Critical Success Factors for High-Rise Buildings Construction Projects using Analytical Hierarchal Process

4.3.1. Prioritization of Success Factors Categories

Based on the judgment of the respondents, the weights of importance were calculated, and categories were prioritized according to the general goal, which is the success of the project. According to the result, contractor-related factors were ranked number one with a weight of 0.276 followed by project management-related factors (0.241), project-related factors (0.195), and client-related factors (0.116), consultant-related factors (0.103), and external-related factors (0.070) respectively. This was generalized and given in Table 4.3 column 3. When computing the weight, the inconsistency rate was 0.03, as it was calculated by expert choice, which is less than the maximum permitted inconsistency of 0.1.

4.3.2. Prioritization of Project Manager-Related Success Factors

Similar to the above cases, factors related to the project manager were weighted and prioritized according to the aggregated judgment of the respondents a total of 15 questions were asked and the weights were computed. Based on these weights, the relevant experience of the project manager (0.240), decision-making effectiveness of the project manager (0.23), good communication between the project manager and the team (0.201), project managers authority and involvement (0.117), the strong commitment of the project manager (0.111), and project managers competency (0.102) were ranked from 1 to 6 respectively according to their respective weight. This was generalized in Table 4.3 column 5. When computing the weight, the inconsistency rate was 0.04, as it was calculated by expert choice, which is less than the maximum permitted inconsistency of 0.1.

4.3.3. Prioritization of Client-Related Success Factors

There were five factors related to the client and a total of 10 questions were asked to compare them. From this, the weight of these factors was calculated and a clear and precise goal/aim by the client was prioritized first with a weight of (0.528). The rest, which include the experience of the client (0.182), size of the client (0.115), moderate change order (0.112), and type of the client (0.064) were ranked from second to fifth respectively according to their weight. This can be observed in Table 4.3 column 5. When computing the weight, the inconsistency rate was 0.02, as it was calculated by expert choice, which is less than the maximum permitted inconsistency of 0.1.

4.3.4. Prioritization of Consultant-Related Success Factors

After six questions were asked to compare factors related to the consultant, the weights of importance were computed to prioritize these factors within their cluster. From this, competency of the consultant (0.441) was found to be the most important factor in the category, and experience of the consultant (0.346), adequate plan and specification (0.143), and consultant track record (0.071) were ranked from second to fourth, respectively. This can be seen in Table 4.3 column 5. When computing the weight, the inconsistency rate was 0.06, as it was calculated by expert choice, which is less than the maximum permitted inconsistency of 0.1.

4.3.5. Prioritization of Contractor-Related Success Factors

The category Construction-related factors were ranked higher than other categories, which shows factors in this category have been given higher priority. From this category, the economic and financial situation of the contractor was prioritized first with a weight of 0.252 followed by contractor equipment advancement (0.216), contractor technical advancement (0.185), contractors experience (0.139), competency of the contractor (0.129), and proper site organization and crew formation (0.078), which were ranked from second to sixth. This was generalized in Table 4.3 column 5. When computing the weight, the inconsistency rate was 0.05, as it was calculated by expert choice, which is less than the maximum permitted inconsistency of 0.1.

4.3.6. Prioritization of External Success Factors

External factors, including economic environment, political environment, social environment, availability of skilled labor, and technological environment were compared pair wisely by asking 10 questions. The weights were then computed, and these factors were

prioritized. Based on the result of economic environment was ranked first with a weight of 0.418 followed by the technological environment (0.264), political environment (0.156), availability of skilled labor (0.095), and social environment (0.066). this data was generalized and given in Table 4.3 column 5. When computing the weight, the inconsistency rate was 0.03, as it was calculated by expert choice, which is less than the maximum permitted inconsistency of 0.1.

4.3.7. Prioritization of Project-Related Success Factors

The last one from the categories, which is project-related factors, contains five factors that were compared and weighted according to the judgment provided by the respondents. Based on that, adequate fund/resource was ranked first with a weight of 0.49 followed by the type of project (0.181), the complexity of the project (0.167), size of the project (0.085), and project bidding method (0.076) respectively. This was generalized and given in Table 4.3 column 5. When computing the weight, the inconsistency rate was 0.08, as it was calculated by expert choice, which is less than the maximum permitted inconsistency of 0.1.

4.3.8. Overall Prioritization of Success Factors

In AHP, there are two comparisons which are local and global comparison. In the first case, all the factors are compared within their cluster or categories only. Each factor or category is compared according to local weights, as it was shown in the above section. The second part of AHP is a global comparison. This comparison is performed on factors only by combining the local weight of the factor with the local weight of their respective categories. In our case, this combination was performed and the global weight of the factor was computed using expert choice. The result shows that adequacy of fund/resource (0.095), economic and financial situation of the contractor (0.070), clear and precise goal by the client (0.061), contractor equipment advancement (0.06), and relevant experience of the project manager (0.055) were the top 5 most important success factor. The weight of all the factors is generalized and given in Table 4.3 column 6 and Table 4.4. When computing the weight, the inconsistency rate was 0.06, as it was calculated by expert choice, which is less than the maximum permitted inconsistency of 0.1. All the results are summarized in table 4.3. The second column contains the list of groups of success factors. Similarly, column 4 contains the list of success factors according to their corresponding groups. On the other hand, columns 3,5, and 6 contain the weight of groups, the local weight of success factors with rankings, and the global weight of success factors with rankings respectively.

Table 4. 3 CFS's ranking based on global and local weight

Level 1: Goal	Level 2: Groups of CFSs	Weights of the group	CFSs	Local weights (Rank)	Global weights (Rank)
1	2	3	4	5	6
	Contractor related factor	0.276	The economic and financial situation of the contractor	0.252 (1)	0.07 (2)
			Contractors' equipment advancement	0.216 (2)	0.06 (4)
			Contractors' technical advancement	0.185 (3)	0.051 (7)
			Contractor's relevant experience	0.139 (4)	0.038 (10)
			Competency of the contractor	0.129 (5)	0.036 (11)
			Proper site organization and crew formation	0.078 (6)	0.022 (18)
	Project manager-related factor	0.241	Relevant experience of the Pm	0.24 (1)	0.058 (5)
			Decision-making effectiveness of the Pm	0.23 (2)	0.055 (6)
			Good communication between the Pm and the team	0.201 (3)	0.048 (8)
			Pm authority and involvement	0.117 (4)	0.028 (15)
			Strong commitment of the Pm	0.111 (5)	0.027 (16)
			Pm competency	0.102 (6)	0.024 (17)
	Project related factor	0.195	Adequate fund/resource	0.49 (1)	0.095 (1)
			Type of the project	0.181 (2)	0.035 (12)
			Complexity of the project	0.167 (3)	0.033 (13)
			Size of the project	0.085 (4)	0.017 (21)
			Project bidding method	0.076 (5)	0.015 (22)

Level 1: Goal	Level 2: Groups of CFSs	Weights of the group	CFSs	Local weights (Rank)	Global weights (Rank)
	2	3	4	5	6
	Client related factors	0.115	Clear and precise goal by the client	0.528 (1)	0.061 (3)
			Experience of the client	0.182 (2)	0.021 (19)
			Size of the client	0.115 (3)	0.013 (23)
			Moderate change order	0.112 (4)	0.013 (23)
			Type of the client	0.064 (5)	0.007 (25)
	Consultant related factor	0.103	Competency of the consultant	0.441 (1)	0.045 (9)
			Experience of the consultant	0.346 (2)	0.036 (11)
			Adequacy of plan and specification	0.143 (3)	0.015 (22)
			Consultant track record	0.071 (4)	0.007 (25)
	External factors	0.07	Economic environment	0.418 (1)	0.029 (14)
			Technological environment	0.264 (2)	0.018 (20)
			Political environment	0.156 (3)	0.011 (24)
			Availability of skill labor	0.095 (4)	0.007 (25)
			Social environment	0.066 (5)	0.005 (26)

Furthermore, the corresponding percentage and overall ranking was given in table 4.4

Table 4. 4 Overall Prioritization of all Success Factors

No	Critical Success Factors	Importance Weight	Percentage Of Weight	Overall Rank
1	Adequate funds/resources	0.095	9.5	1
2	Economic and financial situation of the contractor	0.07	7	2
3	Clear and precise goals of the client	0.061	6.1	3
4	Contractor's equipment advancement	0.06	6	4
5	Relevant experience of the pm	0.058	5.8	5
6	Decision-making effectiveness of the pm	0.055	5.5	6
7	Contractor's technique advancement	0.051	5.1	7
8	Good communication between pm and the team	0.048	4.8	8
9	Competency of the consultant	0.045	4.5	9
10	Contractor's experience of similar projects	0.038	3.8	10
11	Experience of the consultant	0.036	3.6	11
12	Competency of the contractor	0.036	3.6	11
13	Type of the project	0.035	3.5	12
14	Complexity of the project	0.033	3.3	13
15	Economic environment	0.029	2.9	14
16	Pm's authority and involvement	0.028	2.8	15
17	Strong commitment of the pm	0.027	2.7	16
18	Pm's competency	0.024	2.4	17
19	Proper site organization crew formation	0.022	2.2	18
20	Experience of the client	0.021	2.1	19
21	Technological environment	0.018	1.8	20
22	Size of the project	0.017	1.7	21
23	Adequate plan and specification	0.015	1.5	22
24	Project bidding method	0.015	1.5	22
25	Moderate change orders	0.013	1.3	23
26	Size of the client	0.013	1.3	23
27	Political environment	0.011	1.1	24
28	Type of the client	0.007	0.7	25
29	Consultant's track record	0.007	0.7	25
30	Availability of skilled labor	0.007	0.7	25
31	Social environment	0.005	0.5	26

4.4. Discussion

Knowing which success factors influence the success of high-rise building construction projects is worthy work for promoting the success of the project, with the help of professionals' opinions and using the AHP method. This study conducted a deep exploration of success factors. In which, the importance weights for each of the factors were got. The overall weights of success factors were depicted in Table 4.4.

Contractor-related factors are the most important factors in criteria/category-wise comparisons with a weight of 0.276. This was in line with (Belay et al., 2021b) that put this category in the top 3 most important groups, unlike this (Gudienė et al., 2014b) rank this category much lower. In the current study, contractor-related factors are ranked much higher,

contrary to both studies. This may be because, unlike conventional projects targeted in these studies; large construction projects, especially high-rise building projects, require specific attention to accomplish. To achieve efficiency in such types of projects, contractor equipment, and technical advancement are required (Acuna, 2000). Project manager-related factors are the second most important category to the success of the high-rise building project, with a weight of 0.241. Similar to the current study's result, (Ogunlana, 2009) ranks this group third. This is because large project failures are still frequent, mainly due to inadequate management practices (Ribeiro et al., 2013). So, to increase success, more focus should be given to such factor groups. Unlike (Ogunlana, 2009) and the current study, (S. Belay et al., 2021b) ranked this group much lower, this may be due to the variation in the scale of the projects. The factor group that was ranked third was project-related factors with a weight of 0.195. This factor group's ranking corroborates with (Belay et al., 2021b; Gudienė et al., 2014b; Ogunlana, 2009). The project-related factor will focus on the project type, the nature and complexity of the project, and also the size of the project which are the main aspect of the construction project (Alias et al., 2014). The rest categories client-related factors, consultant-related, and external related are ranked fourth to sixth, respectively.

Based on the overall factor-wise comparison, the most important factor is the adequacy of funds/resources with a weight of 0.095. This factor was also prioritized as the top 5 most important by (Belay et al., 2021b;Nguyen et al., 2004; White & Fortune, 2002). This is because money and other resource are imperative to carry out any project especially large-scale projects (Nguyen et al., 2004), since adequate funds and resources are required to ensure the continuity of and construction project without interruption. In doing so, it will help in the minimization of delays and cost overruns (Le-Hoai et al., 2008). The second most important factor in the overall ranking was the economic and financial situation of the contractor, with a weight of 0.07. The current study's finding substantiates with (S. Belay et al., 2021b) finding but disagrees with (Gudienė et al., 2014b) which prioritizes the factor much lower. The reason for this variation is that contractors from developed nations have enormous physical, technological, financial, and human resources that contractors in developing countries can only dream of (Lewis, 2007). Due to this, for developed countries' context, financial stability is almost fulfilled and not that critical, unlike contractors in developing nations. Contractors in developing nations have limited size and shortage of resources (Lewis, 2007). So, archiving economic and financial stability became crucial to conducting project organization. This is because the stability of the contractors' financial

situation is crucial to sustaining the continuity of the project. Since the contractor's unstable financial background consequently leads to delays in the project (Abdul-Rahman et al., 2009). One way of achieving this is by providing these contractors with major organizational and financial support from the governmental support in the form of trade promotions, export credit, guarantees, tax relief, and other financial subsidies (Lewis, 2007).

From the overall factor-wise comparison third most important factor was clear and precise goal/objective with a weight of 0.061. Which was also considered the most important factor by (Belay et al., 2021b;Nguyen et al., 2004). This is because of the client's ability to direct the way the project heads since most projects are client-driven and also conducted to fulfill the need of the client (Lindahl & Ryd, 2007). Clear objectives guide the development of strategy and an action plan. Unless these goals are modified, the activities that the organization may take to attain its goals are seen to be consistent and predictable (Nguyen & Watanabe, 2017). Since most projects are client-driven, clear and precise goals will help in developing strategies and action plans which are critical to the success of the project. One way of achieving this is by having good and continuous briefing throughout the project cycle. Since a good briefing includes a precise description of the functionalities required by the stakeholders for the building project, it gives all stakeholders including the client clear and precise objectives (Shen, 2006). The fourth and seventh-ranked factors are contractor's equipment advancement and contractor's technical advancements with a weight of 0.06 and 0.051 respectively. Unlike the current study both Belay et al., (2021), and Gudienė et al., (2014) ranked these factors much lower. This may be due to the variation in the scale of the project. For large construction projects including high-rise building projects equipment advancement and also technical advancement are crucial to finish the work given time and quality by increasing the efficiency of these projects (Acuna, 2000; Whitt, 2012).

Relevant experience of the pm, decision-making effectiveness of the pm, and good communication between the pm and the team are all project manager-related factors ranked fifth, sixth, and eighth respectively. Such factors can be all-encompassed by leadership and communication skill, which are crucial traits connected to project managers. Such factors are crucial for the successful completion of extensive construction projects, especially high-rise building projects (Nguyen et al., 2004). These factors were also ranked sixth to ninth by (Belay et al., 2021b; Gudienė et al., 2014b; Mathar et al., 2019) which corroborates with the current study's findings. The overall hierarchal structuring of critical success factors for high-rise building projects developed is shown in figure 4.5.

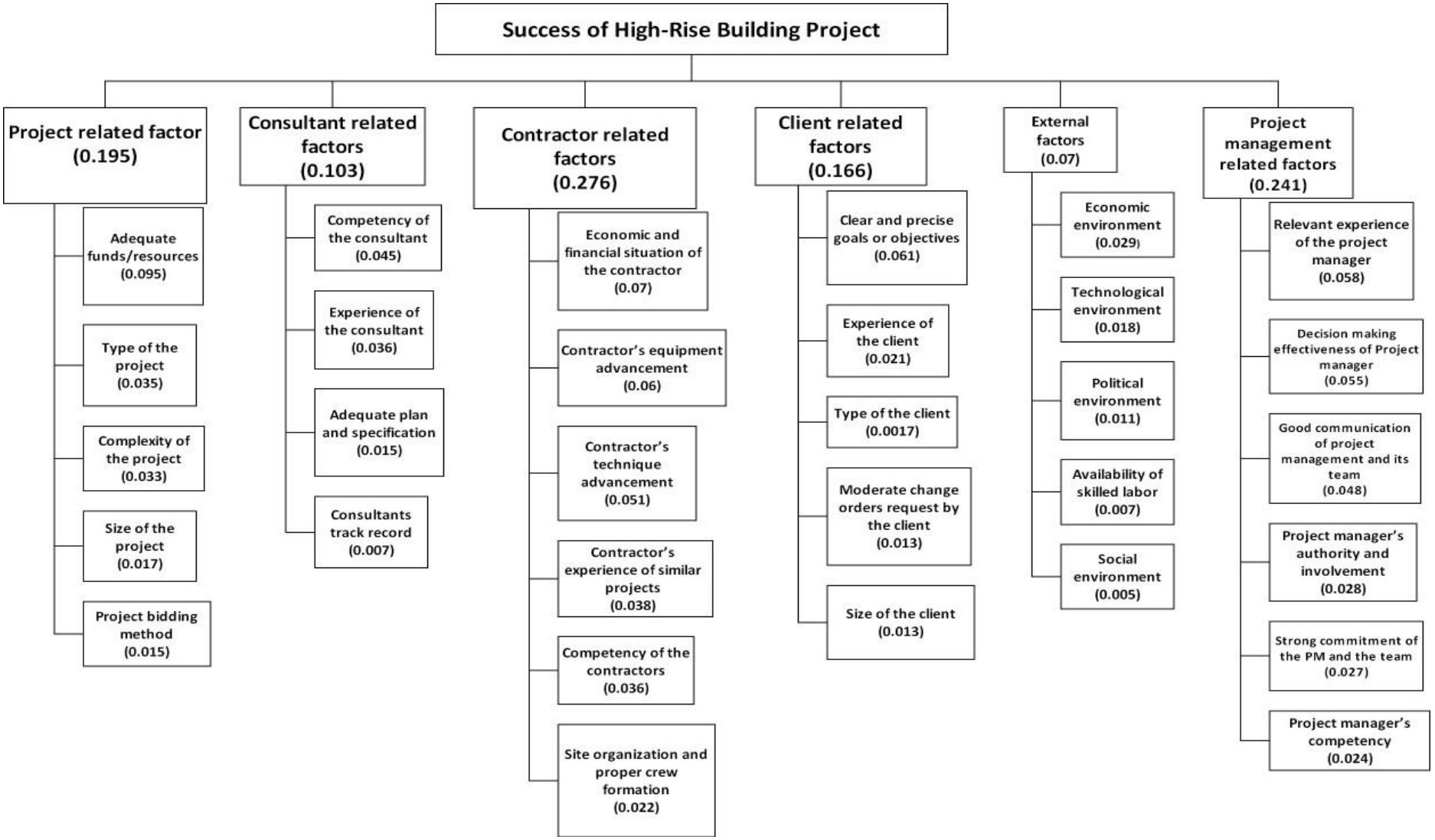

Figure 4. 5 Final analytical hierarchy process structure

4.5. Prioritization of Critical Success Factors for High-Rise Buildings Construction Projects using Interpretive Structural Modeling

After the prioritization of the success factors using AHP was completed, the top 20 factors were selected for further investigation. These factors were given in Table 4.5 and they were analyzed further using ISM to know their interrelationship and also to know which factors are the most influential.

Table 4. 5 Top 20 critical factors based on their relative importance

No	Critical Factors	Symbol	Rank of Importance
1	Adequate funds/resources	E1	1
2	The economic and financial situation of the contractor	E2	2
3	Clear and precise goals of the client	E3	3
4	Contractor's equipment advancement	E4	4
5	Relevant experience of the pm	E5	5
6	Decision-making effectiveness of the pm	E6	6
7	Contractor's technique advancement	E7	7
8	Good communication between pm and the team	E8	8
9	Competency of the consultant	E9	9
10	Contractor's experience with similar projects	E10	10
11	Experience of the consultant	E11	11
12	Competency of the contractor	E12	11
13	Type of the project	E13	12
14	The complexity of the project	E14	13
15	Economic environment	E15	14
16	Pm's authority and involvement	E16	15
17	The strong commitment of the pm	E17	16
18	Pm's competency	E18	17
19	Proper site organization crew formation	E19	18
20	Experience of the client	E20	19
21	Technological environment	E21	20

Based on the judgment of the experts the existence of influence/leads to relationship between any two factors was identified. The author then transformed the result got from the questionnaire into a 21-order matrix called Adjacency Matrix (A). The adjacency matrix, which shows only the direct effects of a factor on all other factors, is given in Appendix A.

As a next step, the reachability matrix, which shows both the direct and indirect effects of a factor on all other factors, was generated. The basic assumption for contextual relationships made by ISM is transitivity. Based on this relation, the reachability matrix is computed and generated, as given in Appendix B. Where D is the dependency power and DP is the driving power.

Based on the result from the reachability matrix, the factors were partitioned into different levels as given in Appendix C. After that, a directed graph (digraph), where the factors correspond to the nodes of the network, where the interrelationships between any two factors are denoted as directional arrows (links) representing the features of the relationships (leads to or has influence on), will be able to pictorially interpret the contextual relationships between each two of these CSFs and their hierarchies. This diagram contains the level of the factor together with the direct and indirect relationship showing arrows. This can be observed in figure 4.6. The data collected and used for computing the hierarchal structure was 28.12% inconsistent, as calculated by the ISM software. This is smaller than the maximum permitted inconsistency of 30% (Alawamleh & Popplewell, 2011). Furthermore, checking the result using Cronbach alpha, the coefficient became 0.929 which is satisfactory.

From the analysis, factors economic environment and technological environment were located at the lowest level, which is level nine, which is the highest priority, and ranked number one. This was followed by factors type of the project and complexity of the project located at level eight that can be ranked second. On the other end, factors contractors' technical advancement, contractors' equipment advancement, the strong commitment of the project manager, and proper crew formation and organization were located at the highest level, which is level one. This level was ranked ninth, followed by the factor relevant experience of the project manager, which is ranked eighth located in level two. Contrary to both extremes, most of the factors are located in the center, which includes from level seven to level three, which includes almost twelve factors which are ranked from the third to the seventh, respectively. From this level, level five has the highest number of factors. It included factors project manager's competency, competency of the consultant, project manager's authority and involvement, good communication between the project manager and the team, decision-making effectiveness of the project manager, and economic and financial situation of the contractor. These factors are ranked fifth based on influence. The detail of the results was given in figure 4.6.

Right after completing the formation of the diagram, an additional analysis, which was MICMAC analysis, was implemented to identify the degrees of relationships between CSFs. The key concepts of MICMAC are driver power and dependence power, which are given in Appendix C. The driver power of each factor is the summation of ones in the row that corresponds to the factor, while the dependence power of each factor is the summation of ones in the corresponding column. According to the driver power and dependence power of

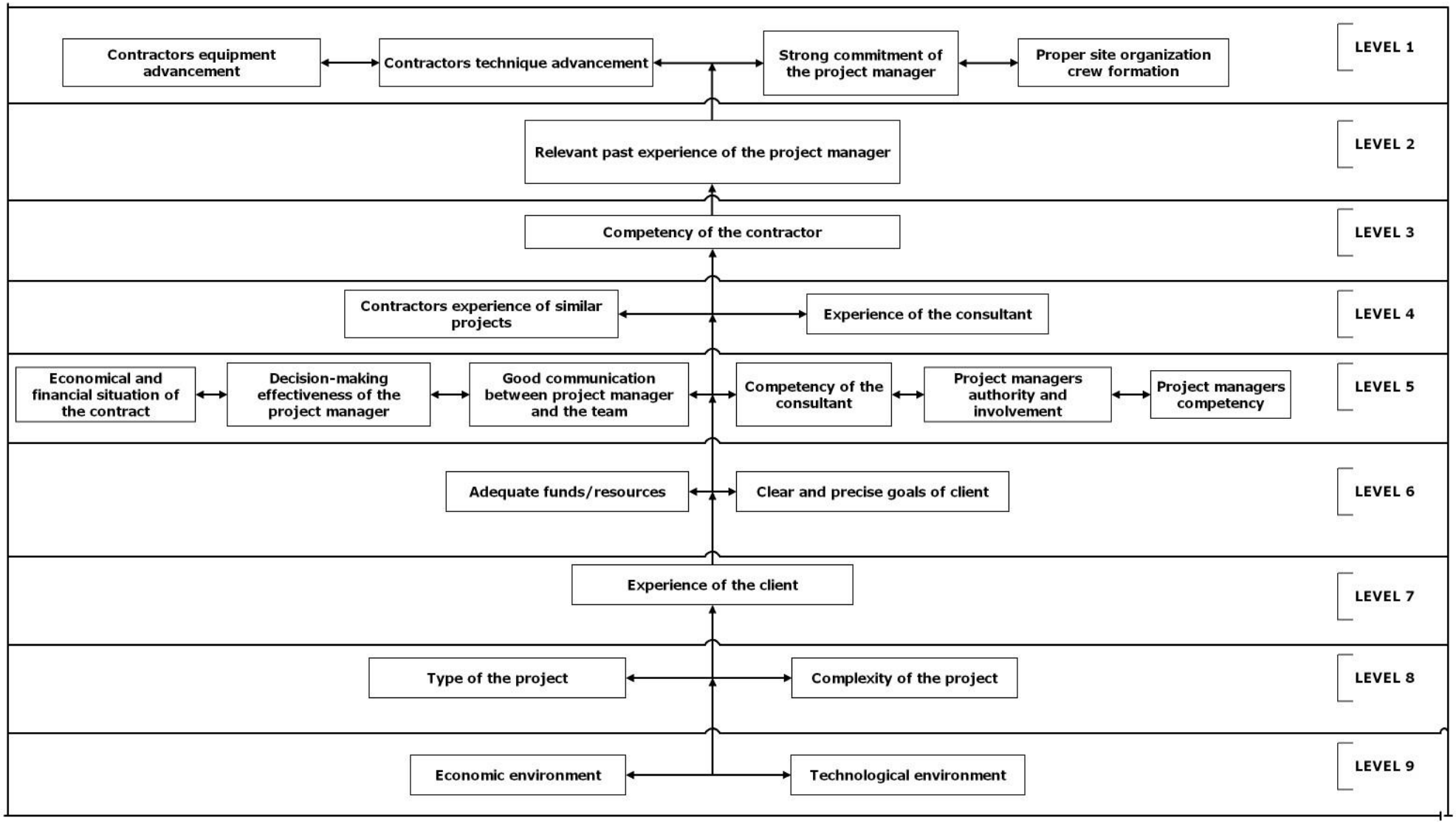

Figure 4. 6 Interpretative structural model for critical success factors

each factor, MICMAC partitions all the factors into four clusters in terms of autonomous, dependent, linkage, and independent groups. According to the analysis conducted, factors economical environment (E15), technological environment (E21), client experience (E20), the complexity of the project (E14), and type of the project (E13) are in the independent cluster but the rest fall under linkage group. The generalized graph is shown in the figure below.

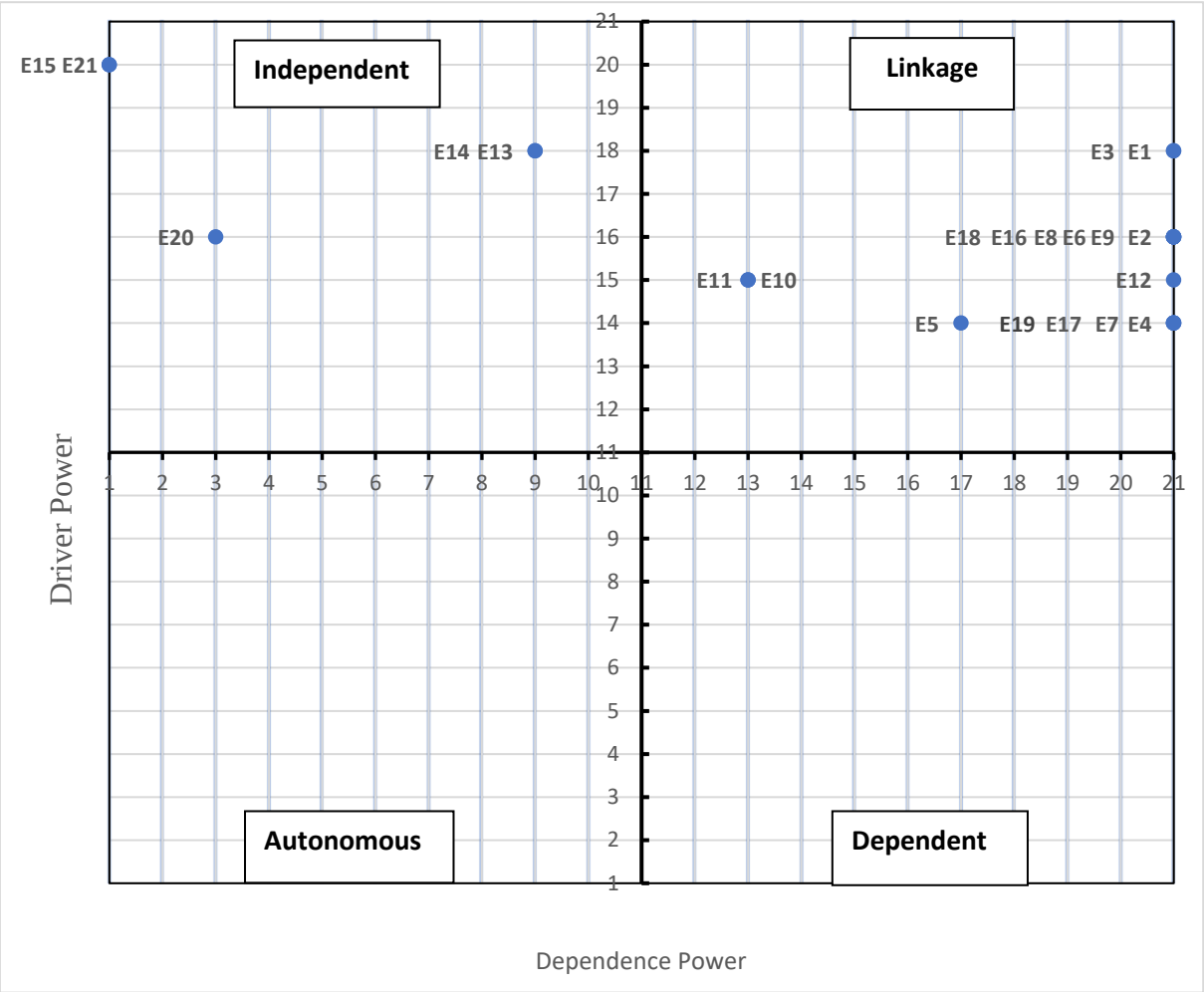

Figure 4. 7 The Result of Micmac Analysis

4.6. Discussion

Figure 4.6 illustrates a clear hierarchy of critical success factors and shows that all 21 critical success factors have a strong interrelationship. It was demonstrated that an economic environment, technological environment, experience of the client, type of the project, and complexity of the project are the root factors or have a profound influence over other critical success factors. The economic environment and technological environment have a direct influence on the complexity and type of the project. This is because these environments are the keys to finding the needed resource, equipment, and other necessary goods for any

construction project, especially high-rise building projects. There was also evidence in a prior study (Rolstadås & Schiefloe, 2017) which claims that the environment surrounding including the economical and technological environment influences the complexity and type of the project.

On the other hand, technological and economical environments influence the experience of the client indirectly. Unlike this, the type of the project and the complexity of the project affect the experience of the client directly. It is obvious that the surrounding environment, including the economical and technological environment, affects the number and the complexity of high-rise building projects. This is because the construction environment including the economical and technological environment affects the development of the construction project (Akanni et al., 2015). So, this will impact the chance of the client's participation in such projects to get experience. Similarly, the technological and economic environments, the type and complexity of the project indirectly influence the availability of funds/resources and the clear and precise goal of the client. This is because the technological environment affect the availability of resources since it affects the production process (Pheng & Hou, 2019b) and economical condition such as inflation will affect the price of materials, and machinery which will deviate the cost of the project which in turn influences the availability of fund and budget (Musarat et al., 2021). Regarding the clear and precise goal of the client, there was evidence from (Patel et al., 2002) that suggested that using technology will facilitate the briefing process, in turn, this will increase the opportunity of the client to have a clear and precise goal or objective. The experience of the client directly influences the availability of adequate funds/resources and the clear and precise goal of the client. This is because the experience of the client determines clients' ability to effectively interact with the construction industry, and increases their levels of confidence and competence to play an active role. Since inexperienced clients may find it difficult to describe their operations to another party and they are not always sure of requirements (Yu et al., 2006), which will affect the availability of funds/resource.

Adequacy of funds/resources and clear and precise goal by the client directly influence the economic and financial situation of the contractor, the decision-making effectiveness of the project manager, project manager competency, good communication between the project manager and the team, competency of the consultant, and project manager authority and involvement. The clients having a clear and precise goal influences the availability of funds/resource. Similarly, the availability of funds/resources will influence the cash flow of

the project which affects the work and duties of all participants (Ghanbaripour et al., 2020). Furthermore, the availability of funds and resources will influence the project management authority and involvement. Since, adequate funding delegate authority (Belassi & Tukel, 2001). Likewise, the availability of funds also influences decision-making effectiveness, since the availability of funds influences the effectiveness of monitoring and evaluation (Njama, 2015), which will affect the decision-making effectiveness. Similarly, the adequacy of funds influences the economic and financial situation of the contractor. This finding was also supported by (Adjei et al., 2018) who concur timely and adequate funding throughout the project will increase cash flow and the working capital of the contractor. The ability of the project manager and the consultant to conduct their duties influences the experience of the contractor, project manager, and contractor directly and indirectly. Having such experience in return affects the competency of the contractor. The other five factors, which are in the last two levels of the hierarchy, are affected directly or indirectly by all the other factors. This shows that these factors are less influential.

Furthermore, the factors were concentrated in two groups of the four MICMAC analysis groups. Factors, including the technological environment, the experience of the client, the economic environment, the complexity of the project, and the type of the project are located in the independent cluster. Factors in this group have strong driving power and weak dependency power and these factors appear at the bottom two levels of the digraph derived from ISM and act as the root source of critical success factors for the success of high-rise building construction projects. According to the law of vital few and trivial many, 80% of effects come from 20% of the causes for many events, controlling these factors should give maximum benefit (Liu et al., 2015). Furthermore, the economic environment and technological environment have the highest driver power, which means the achievement of this factor will very likely impact success. The rest 16 factors are all located in the linkage cluster. The factor in this cluster has a strong dependency and driving power. Any change occurring to the factor of this group will affect other factors in the system.

Comparing the result based on the ISM analysis result and results from the research reviewed; factors considered to be critical tend to vary. The factors that are considered to be critical based on the current ISM analysis result are prioritized much lower based on the AHP analysis of the current study and also studies conducted based on importance. The economic environment which was the most critical factor according to the current result was ranked 13th and 33rd by Belay et al., (2021) and Gudienė et al., (2014) respectively.

Similarly, the technological environment, which was also considered the most critical according to the result of the current ISM analysis, was ranked 54th by Gudienė et al., (2014). Even based on the AHP analysis result of the current study economic and technological environments were ranked 14th and 20th respectively. On the other hand, factors that are considered to be critical based on reviewed literature and also the result from the AHP analysis of the current study were either prioritized the least or in the middle in the ISM analysis of the current study. This includes adequacy of fund clear and precise goal and economical and financial situation of the contractor which are all relatively ranked in the middle level and contractors' technique and equipment advancement which are the least prioritized. This variation in ranking is due to the difference in attributes used to measure the criticality. For both (Belay et al., 2021b; Gudienė et al., 2014b), and also AHP part of the current study importance was used as an attribute used to measure criticality. Contrary to this influence was used as an attribute critically for this section. Using importance as an attribute to measure criticality will give only factors that have a direct or immediate impact. Hence it is cumbersome for the decision maker to trace the actual source of these factors (Gudienė et al., 2013). On the other hand, using influence will yield factors that have a minimal direct impact but are root causes for either success or failure of the projects. This claim was also supported by (Iyer & Sagheer, 2010) who concurs focusing on the root cause rather than focusing on immediate providing activity will be the most efficient way of dealing with success.

4.7. Prioritization Based on The Integrated Hierarchical Structure

The overall objective of this paper is to hierarchically structure critical success factors for high-rise building projects using both importance and influence as a criterion. The factors have been hierarchically structured in both cases but separately.

So this prioritization must be joined. But first to know the relation between the two prioritization spearman's rank correlation was conducted and the correlation coefficient was -0.197. The result shows the ranks have weak negative relation which implies the ranking-based importance and influence are opposite meaning when the ranking based on importance increases the ranking-based influence decreases and vice versa even though the changes are minimal. Furthermore, to facilitate the selection of success factors and integrate the two prioritization and simplify the interpretation quadrant analysis was conducted and the result was given in figure 4.8. According to the result, the six critical success factors fall into the

lower-left quadrant: keep up the good work. These critical success factors were adequate funds/resources, the economic and financial situation of the contractor, clear and precise goals by the client, decision-making effectiveness of the pm, good communication between the pm and the team, and competency of the consultant. These factors not only have the highest importance but also have a strong influence. Given their importance, efforts must be made to maintain these factors for the good performance of the project.

Another four critical success factors that fell into the priority for improvement quadrant were contractor's equipment advancement, relevant experience of the pm, contractor's technique advancement, and contractor's experience of similar projects. The attention to these critical success factors must, accordingly, be assigned the highest priority for improvement of performance. A possible excess supply of resources was indicated for the following critical success factors: type of the project, the complexity of the project, economic environment, project managers' authority and involvement, project managers' competency, the experience of the client, and technological environment. The remaining four critical success factors: proper site organization crew formation, the strong commitment of the project management, competency of the contractor, and experience of the consultant was categorized as low priority.

Figure 4. 8 Result of Quadrant Analysis

4.8. Discussion

Project success serves as a basis for executing, managing, and controlling existing projects, as well as planning and orienting future ones. Project success factors require specific attention to achieve project success; otherwise, if these aspects are not managed appropriately, the project may fail (Sinesilassie et al., 2019). The above discussions, which are given in sections 4.4 and 4.6, are either based on importance or influence but not both. Since the whole of the paper is to identify the factors that are both influential and important, the researcher used quadrant analysis to find these factors. The finding showed that a total of six factors were found to be critical and were located in the keep up the good work quadrant in figure 4.16. This quadrant includes adequate funds/resources, the economic and financial situation of the contractor, clear and precise goals by the client, decision-making effectiveness of the pm, good communication between the pm and the team, and competency of the consultant.

Of these factors, adequate funds and resources is the most critical. This factor was not only ranked as number one based on importance but also ranked fourth according to influence. Not only that but it was also ranked by (Belay et al., 2021b; Nguyen et al., 2004; White & Fortune, 2002) as the top five critical success factors even though it was only based on importance. According to Garbharran et al., (2012) the availability of resources is a further critical factor since adequate funding throughout the project must be ensured for the success of the project. The second factor that is the most important and influential was the clear and precise goal of the client. This factor was not only ranked third based on importance but also ranked fourth based on influence. Even though it was based on only importance (Belay et al., 2021b) also ranked this factor as the most important factor. It is critical for the project that the client has a clear understanding of the project and also has a clear objective which will help all the other participants work easily since the owner is the one who provides the resources and calls the shots (Hendrickson et al., 1989).

The other factor that is this quadrant is the economic and financial situation of the contractor. Even though this factor was prioritized second based on its importance, it was ranked fifth according to influence. A stable financial performance must be achieved through productive cash flow which is the lifeblood of an organization because, without it, outstanding financial obligations cannot be met including lacking sufficient working capital to pay its creditors, suppliers, subcontractors, and employees, which will affect the performance of projects (Omopariola et al., 2019). This shows that economic and financial stability is crucial for the

successful completion of construction projects. This was also supported by (Alzahrani & Emsley, 2013) who claimed that one of the major factors that affect the performance of construction projects is the financial stability of the contractor. And further elaborated that this factor is so critical that The Institute of Building and Institution of Civil Engineering recommended it as a criterion to evaluate contractors. The decision-making effectiveness of the project manager is another factor that has both significant importance and influence compared to other factors in the current study. This factor was ranked sixth according to importance and fifth according to influence. Similarly, Zakaria et al., (2015) argued that effective decision-making is one of the important skills that the project manager possesses to increase the effectiveness of the construction projects.

Another factor that is in the same quadrant is good communication between the project manager and the team. Effective communication is very important and fundamental in project management since teams work together to achieve project goals. Project teams work with each other and they depend on each other, which may lead to conflicts if a miscommunication occurs which leads to failure in achieving the objectives of a project (Malik et al., 2021). So good communication between the project team and the project manager is critical to finishing the project successfully. The competency of the consultant was also in this quadrant with a ninth ranking according to the importance and a fifth according to influence. This factor was also ranked first and second by Mathar et al., (2019), and Ceptureanu et al., (2017) respectively. Project consulting is extremely important, particularly in construction, where it is measured throughout the project budget, project completion, and project quality as needed. But, If a construction project does not have a competent and knowledgeable consultant, the project owners will suffer significant losses, including cost overruns, project delays, poor project quality, and disputes as a result of important requirements being overlooked during the construction process (Masengesho et al., 2020). A competent project consulting team will give the appropriate assistance at the appropriate moment to assist a client in overcoming existing hurdles or avoiding high-level errors in the future, as well as determining and implementing issue solutions more quickly, saving time, and money and facilitating the completion of the project successfully.

Furthermore, critical success factors in each quadrant have similar characteristics. The first quadrant, which is keep up the good work, contains a factor that is both important and also influential. Factors that fail in this quadrant are the most critical. To commit to achieving success the performance of these factors must be assigned the highest priority. The second

one is factors that fall into the priority to improvement quadrant are factors that have higher importance but low influence. These factors are a priority to have immediate improvement of the performance of high-rise building projects. On the other hand, factors located in the possible overkill quadrant tend to have higher influence but low importance. These factors are factors that are root causes and require higher resources to achieve but they are still critical to success in the long term. Unlike the factors in the above three quadrants, factors in the low priority quadrant have relatively both lower importance and influence. These factors have a lower impact on success relative to factors in the other quadrants. The final hierarchal structure, which combines the results from ISM, AHP, and quadrant analysis, is given in Figure 4.9.

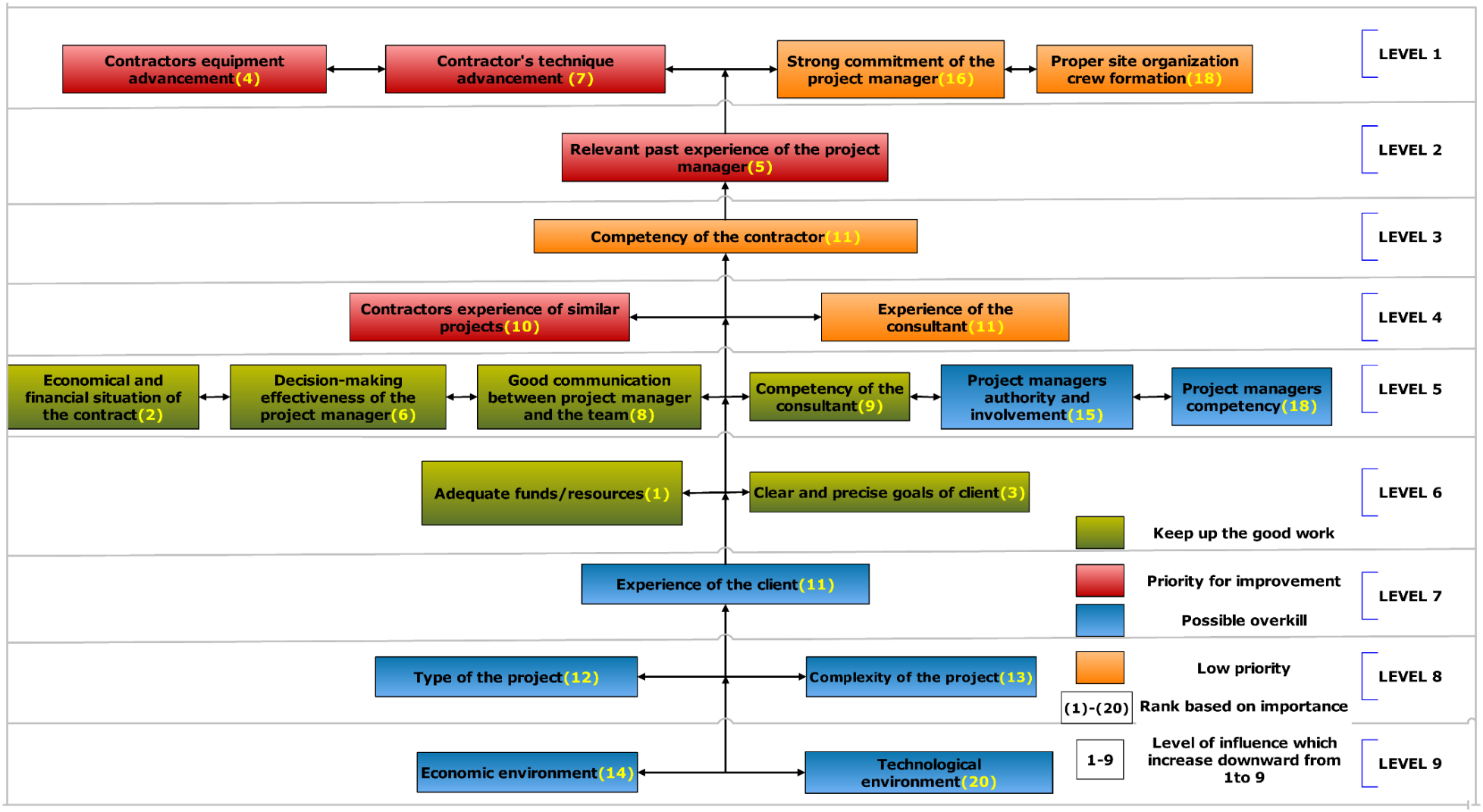

Figure 4. 9 The final hierarchal structure based on influence and importance

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1. Conclusions

Understanding the critical success factors for high-rise building construction projects is conducive to retaining a high success rate for such projects. This study shows how the application of the AHP-ISM integrated method can lead to a better understanding of how various success factors influence the success of such projects. Based on the input from the literature review and opinion from the professionals, the important weights of success factors are quantified and interrelation among them is illustrated by utilizing the properly integrated method. The results revealed that:

- Out of the categories, the contractor-related factors are the most important. In this regard, adequate funds/resources, economic and financial situation of the contractor, clear and precise goal by the client, contractor equipment advancement, and project manager relevant experience are the top five most important critical success factors that affect the success of high-rise building construction projects.
- It was concluded that most of the critical success factors observed have strong interrelationships. Furthermore, in the implementation of high-rise building projects, factors in the independent clusters, which consist of factors with strong driver powers are the most influential factors. In particular, the economic environment, technological environment, the complexity of the project, the type of the project, and the experience of the client are located in the independent cluster with driver powers above 16 and they also appear at the bottom two levels of the digraph derived from ISM. The control of such vital critical success factors in high-rise building projects gives maximum benefit. More specifically, to derive high performance in high-rise building projects, the economic and technological environment surrounding the project should be viable. Which include stability of the economy, high innovation and technological adaptation, low inflation rate, etc.
- Based on the integrated hierarchal structure, factors adequate funds/resources, economic and financial situation of the contractor, clear and precise goals by the client, decision-making effectiveness of the pm, good communication between the pm and the team, and competency of the consultant are extraordinarily crucial because these factors not only occupy higher relative importance weights but are also at the

bottom level of the interpretative structural model. It is also concluded that more emphasis should be placed on these above-mentioned factors.

The research findings provide valuable insights into the perception of and knowledge about critical success factors for high-rise construction projects. Results presented in this paper conceptualize for participants of construction projects their formulation of a strategy to manage the success of the project.

5.2. Recommendation

5.2.1. Recommendation

- It is a recommendation for professionals to use this study to increase the rate of success by focusing on the most critical success factors.
- Based on the hierarchical structure, professionals should use and predict the likelihood of their project and take corrective measures.

5.2.2. Recommendation for Further Study

- For the sake of simplicity of this study, the weights of factors are found through the AHP method, and it is encouraged to apply the Fuzzy AHP method to analyze the vulnerability factors in future research.
- Similar to the first to reduce complexity ISM analysis was conducted, and for future works fuzzy ISM is recommended.
- It is also advantageous for other researchers to implement such methods to conduct their research on topics that are related to analyzing factors.
- Comprehensive research on Ethiopia's construction projects, particularly large projects including high-rise building projects, is still in its inception. More studies should be done based on different methods.

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Appendix

Appendix A: Adjacency Matrix

	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	E18	E19	E20	E21
E1	1	0	1	1	0	0	1	0	1	0	0	1	1	1	0	1	1	1	0	0	0
E2	0	1	0	1	0	1	1	1	1	1	1	1	0	0	0	1	0	1	1	0	0
E3	1	1	1	0	0	1	1	1	1	0	0	1	0	0	0	1	1	1	1	0	0
E4	0	0	0	1	0	1	1	0	0	0	0	1	0	0	0	1	1	1	1	0	0
E5	0	0	1	1	1	1	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0
E6	1	0	1	0	0	1	0	1	1	0	0	1	0	0	0	1	1	1	1	0	0
E7	0	0	0	1	0	1	1	0	1	0	0	1	0	0	0	1	1	1	1	0	0
E8	1	0	1	0	0	1	0	1	0	0	0	1	0	0	0	1	1	1	0	0	0
E9	0	1	1	0	0	0	1	0	1	0	0	1	0	0	0	1	1	1	0	0	0
E10	0	1	0	1	0	1	1	1	0	1	0	1	0	0	0	0	0	0	1	0	0
E11	0	1	1	1	0	1	1	1	1	0	1	0	0	0	0	0	0	0	1	0	0
E12	0	1	0	1	0	1	1	1	1	0	0	1	0	0	0	0	0	1	1	0	0
E13	1	1	0	1	1	1	1	0	1	1	1	1	1	1	0	1	0	1	1	0	0
E14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0
E15	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	0
E16	0	1	0	0	1	1	0	1	1	0	0	1	0	0	0	1	1	1	1	0	0
E17	0	0	0	0	1	1	0	1	1	0	0	1	0	0	0	1	1	1	0	0	0
E18	0	1	0	0	0	1	0	1	1	0	0	1	0	0	0	1	1	1	1	0	0
E19	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	1	0	0
E20	1	0	1	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0
E21	0	0	1	1	1	1	1	1	1	0	1	1	0	1	0	0	0	1	0	1	1

Appendix B: Reachability Matrix

NO	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15	E16	E17	E18	E19	E20	E21	DP	R
E1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0	18	2
E2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	0	0	16	3
E3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0	18	2
E4	1	1	1	1	1	1	1	1	1	0	0	1	0	0	0	1	1	1	1	0	0	14	5
E5	1	1	1	1	1	1	1	1	1	0	0	1	0	0	0	1	1	1	1	0	0	14	5
E6	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	1	1	1	1	0	0	16	3
E7	1	1	1	1	1	1	1	1	1	0	0	1	0	0	0	1	1	1	1	0	0	14	5
E8	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	1	1	1	1	0	0	16	3
E9	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	0	0	16	3
E10	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0	1	1	1	1	0	0	15	4
E11	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0	1	1	1	1	0	0	15	4
E12	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0	1	1	1	1	0	0	15	4
E13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0	18	2
E14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0	18	2
E15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	20	1
E16	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	0	0	16	3
E17	1	1	1	1	1	1	1	1	1	0	0	1	0	0	0	1	1	1	1	0	0	14	5
E18	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	0	0	16	3
E19	1	1	1	1	1	1	1	1	1	0	0	1	0	0	0	1	1	1	1	0	0	14	5
E20	1	1	1	1	0	1	1	1	1	0	0	1	1	1	0	1	1	1	1	1	0	16	3
E21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	20	1
D	21	21	21	21	17	21	21	21	21	13	13	21	9	9	1	21	21	21	21	3	1		
L	1	1	1	1	2	1	1	1	1	3	3	1	4	4	6	1	1	1	1	5	6		

Appendix C: Partition of Critical Success Factor

	Reachability Set	Antecedent Set	Driving power	Dependency power	level
	level 1				
1	1-14,16-19	1-21,	18	21	
2	1-12,16-19	1-21,	16	21	
3	1-14,16-19	1-21,	18	21	
4	1-9,12,16-19	1-21,	14	21	1
5	1-9,12,16-19	1-9,13-19,21	14	17	
6	1-9,12-14,16-19	1-21,	16	21	
7	1-9,12,16-19	1-21,	14	21	1
8	1-9,12-14,16-19	1-21,	16	21	
9	1-12,16-19	1-21,	16	21	
10	1-4,6-12,16-19	1-3,9-16,18,21	15	13	
11	1-4,6-12,16-19	1-3,9-16,18,21	15	13	
12	1-4,6-12,16-19	1-21,	15	21	
13	1-14,16-19	1,3,6,8,13-15,20-21	18	9	
14	1-14,16-19	1,3,6,8,13-15,20-21	18	9	
15	1-20,	15,	20	1	
16	1-12,16-19	1-21,	16	21	
17	1-9,12,16-19	1-21,	14	21	1
18	1-12,16-19	1-21,	16	21	
19	1-9,12,16-19	1-21,	14	21	1
20	1-4,6-9,12-14,16-20	15,20,21,	16	3	
21	1-14,16-21	21,	20	1	
	level 2				
1	1-14,16-19	1-21,	18	21	
2	1-12,16-19	1-21,	16	21	
3	1-14,16-19	1-21,	18	21	
5	1-9,12,16-19	1-9,13-19,21	14	17	2
6	1-9,12-14,16-19	1-21,	16	21	
8	1-9,12-14,16-19	1-21,	16	21	
9	1-12,16-19	1-21,	16	21	
10	1-4,6-12,16-19	1-3,9-16,18,21	15	13	
11	1-4,6-12,16-19	1-3,9-16,18,21	15	13	
12	1-4,6-12,16-19	1-21,	15	21	
13	1-14,16-19	1,3,6,8,13-15,20-21	18	9	
14	1-14,16-19	1,3,6,8,13-15,20-21	18	9	
15	1-20,	15,	20	1	
16	1-12,16-19	1-21,	16	21	
18	1-12,16-19	1-21,	16	21	
20	1-4,6-9,12-14,16-20	15,20,21,	16	3	
21	1-14,16-21	21,	20	1	
	level 3				

1	1-14,16-19	1-21,	18	21	
2	1-12,16-19	1-21,	16	21	
3	1-14,16-19	1-21,	18	21	
6	1-9,12-14,16-19	1-21,	16	21	
8	1-9,12-14,16-19	1-21,	16	21	
9	1-12,16-19	1-21,	16	21	
10	1-4,6-12,16-19	1-3,9-16,18,21	15	13	
11	1-4,6-12,16-19	1-3,9-16,18,21	15	13	
12	1-4,6-12,16-19	1-21,	15	21	3
13	1-14,16-19	1,3,6,8,13-15,20-21	18	9	
14	1-14,16-19	1,3,6,8,13-15,20-21	18	9	
15	1-20,	15,	20	1	
16	1-12,16-19	1-21,	16	21	
18	1-12,16-19	1-21,	16	21	
20	1-4,6-9,12-14,16-20	15,20,21,	16	3	
21	1-14,16-21	21,	20	1	
level 4					
1	1-14,16-19	1-21,	18	21	
2	1-12,16-19	1-21,	16	21	
3	1-14,16-19	1-21,	18	21	
6	1-9,12-14,16-19	1-21,	16	21	
8	1-9,12-14,16-19	1-21,	16	21	
9	1-12,16-19	1-21,	16	21	
10	1-4,6-12,16-19	1-3,9-16,18,21	15	13	4
11	1-4,6-12,16-19	1-3,9-16,18,21	15	13	4
13	1-14,16-19	1,3,6,8,13-15,20-21	18	9	
14	1-14,16-19	1,3,6,8,13-15,20-21	18	9	
15	1-20,	15,	20	1	
16	1-12,16-19	1-21,	16	21	
18	1-12,16-19	1-21,	16	21	
20	1-4,6-9,12-14,16-20	15,20,21,	16	3	
21	1-14,16-21	21,	20	1	
level 5					
1	1-14,16-19	1-21,	18	21	
2	1-12,16-19	1-21,	16	21	5
3	1-14,16-19	1-21,	18	21	
6	1-9,12-14,16-19	1-21,	16	21	5
8	1-9,12-14,16-19	1-21,	16	21	5
9	1-12,16-19	1-21,	16	21	5
13	1-14,16-19	1,3,6,8,13-15,20-21	18	9	
14	1-14,16-19	1,3,6,8,13-15,20-21	18	9	
15	1-20,	15,	20	1	
16	1-12,16-19	1-21,	16	21	5
18	1-12,16-19	1-21,	16	21	5
20	1-4,6-9,12-14,16-20	15,20,21,	16	3	

21	1-14,16-21	21,	20	1	
level 6					
1	1-14,16-19	1-21,	18	21	6
3	1-14,16-19	1-21,	18	21	6
13	1-14,16-19	1,3,6,8,13-15,20-21	18	9	
14	1-14,16-19	1,3,6,8,13-15,20-21	18	9	
15	1-20,	15,	20	1	
20	1-4,6-9,12-14,16-20	15,20,21,	16	3	
21	1-14,16-21	21,	20	1	
level 7					
13	1-14,16-19	1,3,6,8,13-15,20-21	18	9	
14	1-14,16-19	1,3,6,8,13-15,20-21	18	9	
15	1-20,	15,	20	1	
20	1-4,6-9,12-14,16-20	15,20,21,	16	3	7
21	1-14,16-21	21,	20	1	
level 8					
13	1-14,16-19	1,3,6,8,13-15,20-21	18	9	8
14	1-14,16-19	1,3,6,8,13-15,20-21	18	9	8
15	1-20,	15,	20	1	
21	1-14,16-21	21,	20	1	
level 9					
15	1-20,	15,	18	9	9
21	1-14,16-21	21,	20	1	9

Appendix D: Questionaries of ISM

Adama Science and Technology University

School of Civil Engineering and Architecture

Department of Construction Engineering and Management Questionnaire survey for study paper on

Hierarchal Structuring of Critical Success Factor Affecting High Rise Building Construction Projects in Addis Ababa

This research survey is designed to fulfill an academic requirement for MSc program in Construction Engineering and Management at the Adama Science and Technology University. Those who involve in the construction of high-rise building projects in Addis Ababa are kindly requested to contribute to this research work.

The result of this survey is intended to serve only for academic purpose and will be treated with strict confidentiality. The name of institutions participated will be recorded confidentially. Thank you in advance for your willingness to fill the questionnaires and returning them back on time. Your open response is highly appreciated.

Name- Bisrat Teshome

Phone NO – 0920199700

Advisor- Fikreyesus Demeke (PhD)

General information

Name of the organization										
Respondents position in the organization.										
Level of education of the respondent										
Relevant working		1-5 years		6- 10 years		11-15 years		16-21 years		more than 20 years

Objective of the study

The general objective of this study is to identify and find the interrelation between this success factors for high-rise building projects in Addis Ababa.

Method

Identify the relationship between several success factor which are Influcial to other factors which affect the success of high-rise building construction and calculate their influence on each other using Interpretive structural modelling (ISM).

Instruction

The respondent is required to identify only the direct interrelationship between these factors based on which factor leads to the occurrence of the other factor. An Example is given below. Based on that please fill the rest.

Example

CASE 1: If you think factor **"A"** leads to or influence "**B"** mark the relation column by "→"

CASE 2: If you think factor **"B"** leads to or influence **"A"** mark the relation column by "←"

CASE 3: If you think **both** factors lead to or influence **one another** mark the relation column by "↔"

CASE 4: If you think **both** factors do not lead to or influence **one another** mark the relation column by "×"

Case 1	**"A"**	→	**"B"**
Case 2	**"A"**	←	**"B"**
Case 3	**"A"**	↔	**"B"**
Case 4	**"A"**	×	**"B"**

A	RELATION	B
Availability Adequate funds/resources		Economical and financial situation of the contractor
Availability Adequate funds/resources		Clear and precise goals of the client
Availability Adequate funds/resources		Contractor’s equipment advancement
Availability Adequate funds/resources		Relevant past experience of the project manager
Availability Adequate funds/resources		Decision-making effectiveness of the project manager
Availability Adequate funds/resources		Contractor’s technique advancement
Availability Adequate funds/resources		Good communication between project manager and the team
Availability Adequate funds/resources		Competency of the consultant
Availability Adequate funds/resources		Contractor's experience of similar projects
Availability Adequate funds/resources		Experience of the consultant
Availability Adequate funds/resources		Competency of the contractor
Availability Adequate funds/resources		Type of the project
Availability Adequate funds/resources		Complexity of the project
Availability Adequate funds/resources		Economic environment
Availability Adequate funds/resources		Project manager's authority and involvement
Availability Adequate funds/resources		Strong commitment of the project manager
Availability Adequate funds/resources		Project manager’s competency
Availability Adequate funds/resources		Proper site organization crew formation
Availability Adequate funds/resources		Experience of the client
Availability Adequate funds/resources		Technological environment
Economical and financial situation of the contractor		Clear and precise goals of the client
Economical and financial situation of the contractor		Contractor’s equipment advancement
Economical and financial situation of the contractor		Relevant past experience of the project manager
Economical and financial situation of the contractor		Decision-making effectiveness of the project manager
Economical and financial situation of the contractor		Contractor’s technique advancement
Economical and financial situation of the contractor		Good communication between project manager and the team

Economical and financial situation of the contractor		Competency of the consultant
Economical and financial situation of the contractor		Contractor's experience on similar projects
Economical and financial situation of the contractor		Experience of the consultant
Economical and financial situation of the contractor		Competency of the contractor
Economical and financial situation of the contractor		Type of the project
Economical and financial situation of the contractor		Complexity of the project
Economical and financial situation of the contractor		Economic environment
Economical and financial situation of the contractor		Project manager's authority and involvement
Economical and financial situation of the contractor		Strong commitment of the project manager
Economical and financial situation of the contractor		Project manager’s competency
Economical and financial situation of the contractor		Proper site organization crew formation
Economical and financial situation of the contractor		Experience of the client
Economical and financial situation of the contractor		Technological environment
Clear and precise goals of the client		Contractor’s equipment advancement
Clear and precise goals of the client		Relevant past experience of the project manager
Clear and precise goals of the client		Decision-making effectiveness of the project manager
Clear and precise goals of the client		Contractor’s technique advancement
Clear and precise goals of the client		Good communication between project manager and the team
Clear and precise goals of the client		Competency of the consultant
Clear and precise goals of the client		Contractor's experience of similar projects
Clear and precise goals of the client		Experience of the consultant
Clear and precise goals of the client		Competency of the contractor
Clear and precise goals of the client		Type of the project
Clear and precise goals of the client		Complexity of the project
Clear and precise goals of the client		Economic environment
Clear and precise goals of the client		Project manager's authority and involvement
Clear and precise goals of the client		Strong commitment of the project manager

Clear and precise goals of the client		Project manager’s competency
Clear and precise goals of the client		Proper site organization crew formation
Clear and precise goals of the client		Experience of the client
Clear and precise goals of the client		Technological environment
Contractor's equipment advancement		Relevant past experience of the project manager
Contractor's equipment advancement		Decision-making effectiveness of the project manager
Contractor's equipment advancement		Contractor’s technique advancement
Contractor's equipment advancement		Good communication between project manager and the team
Contractor's equipment advancement		Competency of the consultant
Contractor's equipment advancement		Contractor's experience of similar projects
Contractor's equipment advancement		Experience of the consultant
Contractor's equipment advancement		Competency of the contractor
Contractor's equipment advancement		Type of the project
Contractor's equipment advancement		Complexity of the project
Contractor's equipment advancement		Economic environment
Contractor's equipment advancement		Project manager's authority and involvement
Contractor's equipment advancement		Strong commitment of the project manager
Contractor's equipment advancement		Project manager’s competency
Contractor's equipment advancement		Proper site organization crew formation
Contractor's equipment advancement		Experience of the client
Contractor's equipment advancement		Technological environment
Relevant past experience of the project manager		Decision-making effectiveness of the project manager
Relevant past experience of the project manager		Contractor’s technique advancement
Relevant past experience of the project manager		Good communication between project manager and the team
Relevant past experience of the project manager		Competency of the consultant
Relevant past experience of the project manager		Contractor's experience of similar projects
Relevant past experience of the project manager		Experience of the consultant

Relevant past experience of the project manager		Competency of the contractor
Relevant past experience of the project manager		Type of the project
Relevant past experience of the project manager		Complexity of the project
Relevant past experience of the project manager		Economic environment
Relevant past experience of the project manager		Project manager's authority and involvement
Relevant past experience of the project manager		Strong commitment of the project manager
Relevant past experience of the project manager		Project manager’s competency
Relevant past experience of the project manager		Proper site organization crew formation
Relevant past experience of the project manager		Experience of the client
Relevant past experience of the project manager		Technological environment
Decision-making effectiveness of the project manager		Contractor’s technique advancement
Decision-making effectiveness of the project manager		Good communication between project manager and the team
Decision-making effectiveness of the project manager		Competency of the consultant
Decision-making effectiveness of the project manager		Contractor's experience of similar projects
Decision-making effectiveness of the project manager		Experience of the consultant
Decision-making effectiveness of the project manager		Competency of the contractor
Decision-making effectiveness of the project manager		Type of the project
Decision-making effectiveness of the project manager		Complexity of the project
Decision-making effectiveness of the project manager		Economic environment
Decision-making effectiveness of the project manager		Project manager's authority and involvement
Decision-making effectiveness of the project manager		Strong commitment of the project manager
Decision-making effectiveness of the project manager		Project manager’s competency
Decision-making effectiveness of the project manager		Proper site organization crew formation
Decision-making effectiveness of the project manager		Experience of the client
Decision-making effectiveness of the project manager		Technological environment
Contractor's technique advancement		Good communication between project manager and the team
Contractor's technique advancement		Competency of the consultant

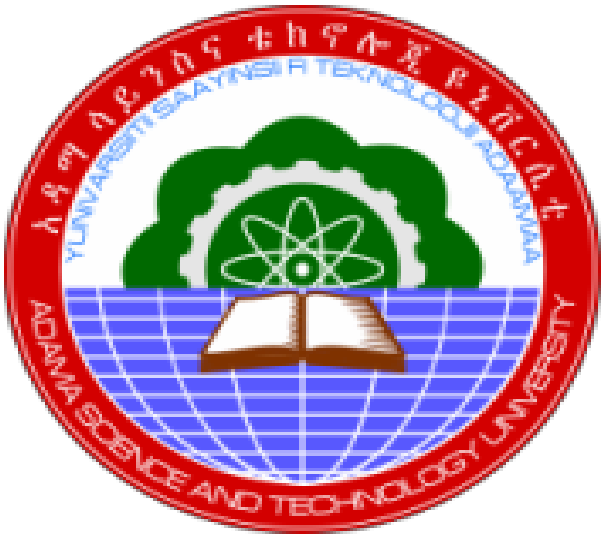
Contractor's technique advancement		Contractor's experience of similar projects
Contractor's technique advancement		Experience of the consultant
Contractor's technique advancement		Competency of the contractor
Contractor's technique advancement		Type of the project
Contractor's technique advancement		Complexity of the project
Contractor's technique advancement		Economic environment
Contractor's technique advancement		Project manager's authority and involvement
Contractor's technique advancement		Strong commitment of the project manager
Contractor's technique advancement		Project manager’s competency
Contractor's technique advancement		Proper site organization crew formation
Contractor's technique advancement		Experience of the client
Contractor's technique advancement		Technological environment
Good communication between project manager and the team		Competency of the consultant
Good communication between project manager and the team		Contractor's experience of similar projects
Good communication between project manager and the team		Experience of the consultant
Good communication between project manager and the team		Competency of the contractor
Good communication between project manager and the team		Type of the project
Good communication between project manager and the team		Complexity of the project
Good communication between project manager and the team		Economic environment
Good communication between project manager and the team		Project manager's authority and involvement
Good communication between project manager and the team		Strong commitment of the project manager
Good communication between project manager and the team		Project manager’s competency
Good communication between project manager and the team		Proper site organization crew formation
Good communication between project manager and the team		Experience of the client
Good communication between project manager and the team		Technological environment
Competency of the consultant		Contractor's experience of similar projects
Competency of the consultant		Experience of the consultant
Competency of the consultant		Competency of the contractor

Competency of the consultant		Type of the project
Competency of the consultant		Complexity of the project
Competency of the consultant		Economic environment
Competency of the consultant		Project manager's authority and involvement
Competency of the consultant		Strong commitment of the project manager
Competency of the consultant		Project manager’s competency
Competency of the consultant		Proper site organization crew formation
Competency of the consultant		Experience of the client
Competency of the consultant		Technological environment
Contractor's experience of similar projects		Experience of the consultant
Contractor's experience of similar projects		Competency of the contractor
Contractor's experience of similar projects		Type of the project
Contractor's experience of similar projects		Complexity of the project
Contractor's experience of similar projects		Economic environment
Contractor's experience of similar projects		Project manager's authority and involvement
Contractor's experience of similar projects		Strong commitment of the project manager
Contractor's experience of similar projects		Project manager’s competency
Contractor's experience of similar projects		Proper site organization crew formation
Contractor's experience of similar projects		Experience of the client
Contractor's experience of similar projects		Technological environment
Experience of the consultant		Competency of the contractor
Experience of the consultant		Type of the project
Experience of the consultant		Complexity of the project
Experience of the consultant		Economic environment
Experience of the consultant		Project manager's authority and involvement
Experience of the consultant		Strong commitment of the project manager
Experience of the consultant		Project manager’s competency
Experience of the consultant		Proper site organization crew formation
Experience of the consultant		Experience of the client
Experience of the consultant		Technological environment
Competency of the contractor		Type of the project
Competency of the contractor		Complexity of the project
Competency of the contractor		Economic environment
Competency of the contractor		Project manager's authority and involvement
Competency of the contractor		Strong commitment of the project manager

Competency of the contractor		Project manager’s competency
Competency of the contractor		Proper site organization crew formation
Competency of the contractor		Experience of the client
Competency of the contractor		Technological environment
Type of the project		Complexity of the project
Type of the project		Economic environment
Type of the project		Project manager's authority and involvement
Type of the project		Strong commitment of the project manager
Type of the project		Project manager’s competency
Type of the project		Proper site organization crew formation
Type of the project		Experience of the client
Type of the project		Technological environment
Complexity of the project		Economic environment
Complexity of the project		Project manager's authority and involvement
Complexity of the project		Strong commitment of the project manager
Complexity of the project		Project manager’s competency
Complexity of the project		Proper site organization crew formation
Complexity of the project		Experience of the client
Complexity of the project		Technological environment
Economic environment		Project manager's authority and involvement
Economic environment		Strong commitment of the project manager
Economic environment		Project manager’s competency
Economic environment		Proper site organization crew formation
Economic environment		Experience of the client
Economic environment		Technological environment
Project manager's authority and involvement		Strong commitment of the project manager
Project manager's authority and involvement		Project manager’s competency
Project manager's authority and involvement		Proper site organization crew formation
Project manager's authority and involvement		Experience of the client
Project manager's authority and involvement		Technological environment
Strong commitment of the project manager		Project manager’s competency
Strong commitment of the project manager		Proper site organization crew formation
Strong commitment of the project manager		Experience of the client
Strong commitment of the project manager		Technological environment

Project manager’s competency		Proper site organization crew formation
Project manager’s competency		Experience of the client
Project manager’s competency		Technological environment
Proper site organization crew formation		Experience of the client
Proper site organization crew formation		Technological environment
Experience of the client		Technological environment

Appendix E: Questineruy for AHP



Adama Science and Technology University

School of Civil Engineering and Architecture

Department of Construction Engineering and Management Questionnaire survey for study paper on

Hierarchal Structuring of Critical Success Factor Affecting High Rise Building Construction Projects in Addis Ababa

This research survey is designed to fulfill an academic requirement for MSc program in Construction Engineering and Management at the Adama Science and Technology University. Those who involve in the construction of high-rise building projects in Addis Ababa are kindly requested to contribute to this research work.

The result of this survey is intended to serve only for academic purpose and will be treated with strict confidentiality. The name of institutions participated will be recorded confidentially. Thank you in advance for your willingness to fill the questionnaires and returning them back on time. Your open response is highly appreciated.

Name- Bisrat Teshome

Phone NO - 0920199700

Advisor- Fikreyesus Demeke (PhD)

General information

Name of the organization										
Respondents position in the organization.										
Level of education of the respondent										
Relevant working		1-5 years		6- 10 years		11-15		16-21 years		more than 20 years

Objective of the study

The general objective of this study is to identify and prioritize critical factors for the successful and efficient implementation high rise building projects in Addis Ababa.

Method

Conduct a pair-wise comparison to identify the weight of several success factor which are important to success of high-rise building construction and to calculate an overall score of the factors using the Analytic Hierarchy Process (AHP).

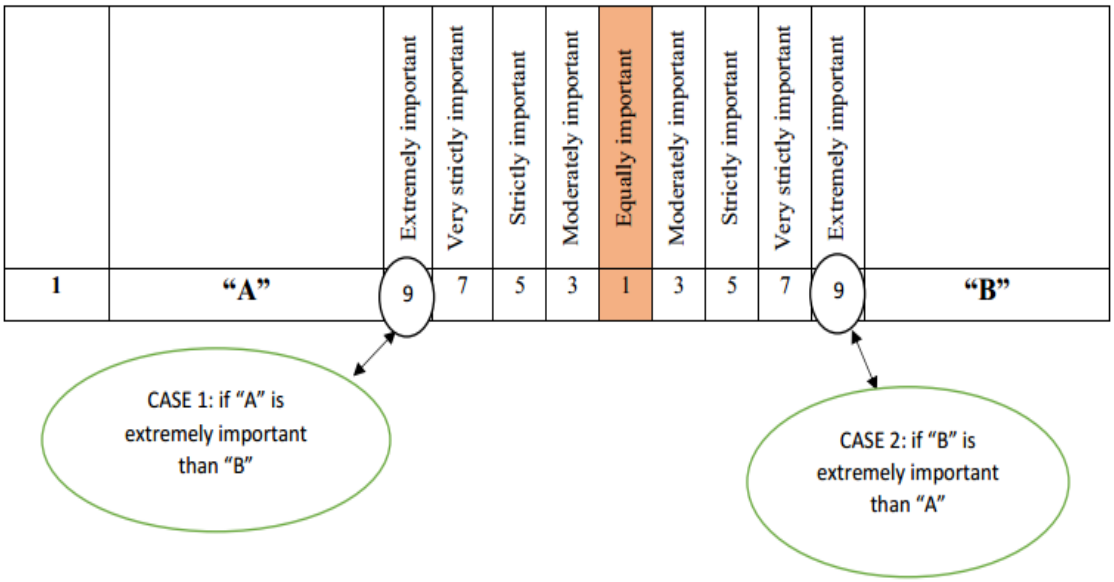
Instruction

The respondent is required to compare these factors based on their importance to the success of high-rise building projects.

Example

CASE 1: If you think factor **"A"** is extremely important than factor **"B"** circle or mark the numbers **"9"** **<u>to the left of the center</u>**

CASE 2: If you think factor **"B"** is extremely important than factor **"A"** circle or mark the numbers **"9"** to **<u>the right of the center</u>**



Categories	Success
Project related factors	• Adequate funds/resources • Complexity of project • Size of the project • Type of the project (residential, commercial or real state) • Project bidding and delivery method
Project management related factors	• Project manager's competency, • Project manager's authority and involvement • Relevant experience of the project manager • Good communication of project management and its team • Strong commitment of the PM and the team • Decision making effectiveness of Project manager
Contractor related factors	• Competency of the contractors • Economic and financial situation of the contractor • Contractor's technique advancement • Contractor's equipment advancement • Contractor's experience of similar projects • Site organization and proper crew formation (Effective allocation of man power)
External factors	• Political environment (corruption, instability) • Social environment (public acceptance towards the project) • Economic environment (stable economic conditions and sound economic policy) • Availability of skilled labor • Technological environment
Consultant related factors	• Consultants track record • Experience of the consultant • Competency of the consultant • Adequate plan and specification
Client related factors	• Type (private vs. public) • Size of the client or organization (Financial capability of the client) • Experience of the client • Clear and precise goals or objectives • Moderate change orders request by the client

1. **Comparation of Categories of Critical Success Factors According to Their Impact on Success**

		Extremely important	Very strongly important	strongly important	Moderately important	Equally	Moderately important	strongly important	Very strongly important	Extremely important	
1	Client related factors	9	7	5	3	1	3	5	7	9	Consultant related factors
2	Client related factors	9	7	5	3	1	3	5	7	9	External factors
3	Client related factors	9	7	5	3	1	3	5	7	9	Contractor related factors
4	Client related factors	9	7	5	3	1	3	5	7	9	Project management related factors
5	Client related factors	9	7	5	3	1	3	5	7	9	Project related factors
6	Consultant related factors	9	7	5	3	1	3	5	7	9	External factors
7	Consultant related factors	9	7	5	3	1	3	5	7	9	Contractor related factors
8	Consultant related factors	9	7	5	3	1	3	5	7	9	Project management related factors
9	Consultant related factors	9	7	5	3	1	3	5	7	9	Project related factors
10	External factors	9	7	5	3	1	3	5	7	9	Contractor related factors
11	External factors	9	7	5	3	1	3	5	7	9	Project management related factors
12	External factors	9	7	5	3	1	3	5	7	9	Project related factors
13	Contractor related factors	9	7	5	3	1	3	5	7	9	Project management related factors
14	Contractor related factors	9	7	5	3	1	3	5	7	9	Project related factors
15	Project management related factors	9	7	5	3	1	3	5	7	9	Project related factors

2. **Comparison of Project-Related Factors According to Their Impact on Success**

		Extremely important	Very strongly important	strongly important	Moderately important	Equally important	Moderately important	strongly important	Very strongly important	Extremely important	
1	Project bidding method	9	7	5	3	1	3	5	7	9	Type of the project
2	Project bidding method	9	7	5	3	1	3	5	7	9	Size of the project
3	Project bidding method	9	7	5	3	1	3	5	7	9	Adequate funds/resources
4	Type of the project	9	7	5	3	1	3	5	7	9	Size of the project
5	Type of the project	9	7	5	3	1	3	5	7	9	Adequate funds/resources
6	Size of the project	9	7	5	3	1	3	5	7	9	Adequate funds/resources
7	Complexity of the project	9	7	5	3	1	3	5	7	9	Type of the project
8	Complexity of the project	9	7	5	3	1	3	5	7	9	Size of the project
9	Complexity of the project	9	7	5	3	1	3	5	7	9	Adequate funds/resources
10	Complexity of the project	9	7	5	3	1	3	5	7	9	Project bidding method

3. Comparison of Contractor Related Factors According to Their Impact on Success

		Extremely important	Very strongly important	strongly important	Moderately important	Equally important	Moderately important	strongly important	Very strongly important	Extremely important	
1	Proper Site organization and proper crew formation	9	7	5	3	1	3	5	7	9	Contractor's experience of similar projects
2	Proper Site organization and proper crew formation	9	7	5	3	1	3	5	7	9	Contractor's technique advancement
3	Proper Site organization and proper crew formation	9	7	5	3	1	3	5	7	9	Contractor's equipment advancement
4	Proper Site organization and proper crew formation	9	7	5	3	1	3	5	7	9	Economic and financial situation of the contractor
5	Proper Site organization and proper crew formation	9	7	5	3	1	3	5	7	9	Competency of the contractor
6	Contractor's experience of similar projects	9	7	5	3	1	3	5	7	9	Contractor's equipment advancement
7	Contractor's experience of similar projects	9	7	5	3	1	3	5	7	9	Contractor's technique advancement
8	Contractor's experience of similar projects	9	7	5	3	1	3	5	7	9	Economic and financial situation of the contractor
9	Contractor's experience of similar projects	9	7	5	3	1	3	5	7	9	Competency of the contractors'
10	Contractor's equipment advancement	9	7	5	3	1	3	5	7	9	Contractor's technique advancement
11	Contractor's equipment advancement	9	7	5	3	1	3	5	7	9	Economic and financial situation of the contractor
12	Contractor's equipment advancement	9	7	5	3	1	3	5	7	9	Competency of the contractor
13	Contractor's technique advancement	9	7	5	3	1	3	5	7	9	Economic and financial situation of the contractor
14	Contractor's technique advancement	9	7	5	3	1	3	5	7	9	Competency of the contractors
15	Economic and financial situation of the contractor	9	7	5	3	1	3	5	7	9	Competency of the contractors

4. Comparison of Consultant Related Factors According to Their Impact on Success

		Extremely important	Very strongly important	strongly important	Moderately important	Equally important	Moderately important	strongly important	Very strongly important	Extremely important	
1	Competency of the consultant	9	7	5	3	1	3	5	7	9	Experience of the consultant
2	Competency of the consultant	9	7	5	3	1	3	5	7	9	Adequate plan and specification
3	Experience of the consultant	9	7	5	3	1	3	5	7	9	Adequate plan and specification
4	Consultants track record	9	7	5	3	1	3	5	7	9	Competency of the consultant
5	Consultants track record	9	7	5	3	1	3	5	7	9	Experience of the consultant
6	Consultants track record	9	7	5	3	1	3	5	7	9	Adequate plan and specification

5. Comparison of Project manager Related Factors According to Their Impact on Success

		Extremely important	Very strongly important	strongly important	Moderately important	Equally important	Moderately important	strongly important	Very strongly important	Extremely important	
1	Strong commitment of the project manager	9	7	5	3	1	3	5	7	9	Good communication project manager and the team
2	Strong commitment of the project manager	9	7	5	3	1	3	5	7	9	Decision-making effectiveness of the project manager
3	Strong commitment of the project manager	9	7	5	3	1	3	5	7	9	Relevant past experience project manager
4	Strong commitment of the project manager	9	7	5	3	1	3	5	7	9	Project manager competency
5	Strong commitment of the project manager	9	7	5	3	1	3	5	7	9	Project manager authority and
6	Good communication project management and the team	9	7	5	3	1	3	5	7	9	Decision-making effectiveness of the project manager

7	Good communication project management and the team	9	7	5	3	1	3	5	7	9	Relevant past experience project manager
8	Good communication project management	9	7	5	3	1	3	5	7	9	Project manager's competency
9	Good communication project management and the team	9	7	5	3	1	3	5	7	9	Project manager's authority and involvement
10	Decision-making effectiveness of the project manager	9	7	5	3	1	3	5	7	9	Relevant past experience project manager
11	Decision-making effectiveness of the project manager	9	7	5	3	1	3	5	7	9	Project manager's competency
12	Decision-making effectiveness of the project manager	9	7	5	3	1	3	5	7	9	Project manager's authority and involvement
13	Relevant past experience project manager	9	7	5	3	1	3	5	7	9	Project manager's competency
14	Relevant past experience project manager	9	7	5	3	1	3	5	7	9	Project manager's authority and involvement
15	Project manager's authority and involvement	9	7	5	3	1	3	5	7	9	Project manager's competency

6. Comparison of External Environment Related Factors According to Their Impact on Success

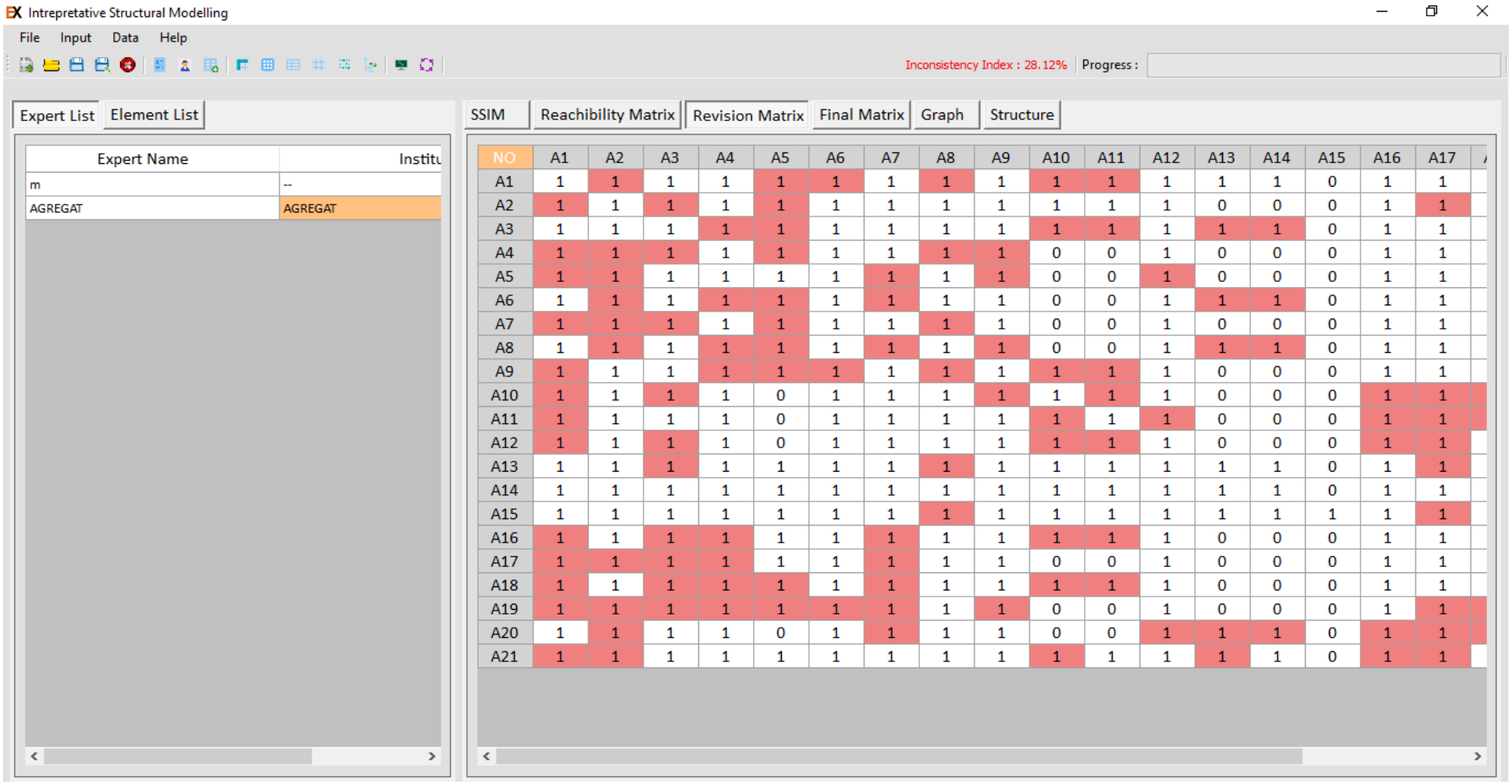
		Extremely	Very strongly	strongly	Moderately	Equally	Moderately	strongly	Very strongly	Extremely	
1	Technological environment	9	7	5	3	1	3	5	7	9	Availability of skilled labor
2	Technological environment	9	7	5	3	1	3	5	7	9	Economic environment
3	Technological environment	9	7	5	3	1	3	5	7	9	Social environment
4	Technological environment	9	7	5	3	1	3	5	7	9	Political environment
5	Availability of skilled labor	9	7	5	3	1	3	5	7	9	Economic environment
6	Availability of skilled labor	9	7	5	3	1	3	5	7	9	Social environment
7	Availability of skilled labor	9	7	5	3	1	3	5	7	9	Political environment
8	Economic environment	9	7	5	3	1	3	5	7	9	Social environment
9	Economic environment	9	7	5	3	1	3	5	7	9	Political environment
10	Social environment	9	7	5	3	1	3	5	7	9	Political environment

7. Comparison of Client-Related Factors According to Their Impact on Success

		Extremely important	Very strongly important	strongly important	Moderately important	Equally important	Moderately important	strongly important	Very strongly important	Extremely important	
1	Moderate change orders	9	7	5	3	1	3	5	7	9	Clear and precise goals/objective
2	Moderate change orders	9	7	5	3	1	3	5	7	9	Experience of the client
3	Moderate change orders	9	7	5	3	1	3	5	7	9	Size of the client
4	Clear and precise	9	7	5	3	1	3	5	7	9	Experience of the client
5	Clear and precise	9	7	5	3	1	3	5	7	9	Size of the client
6	Experience of the client	9	7	5	3	1	3	5	7	9	Size of the client
7	Type of the client	9	7	5	3	1	3	5	7	9	Clear and precise goals/objective
8	Type of the client	9	7	5	3	1	3	5	7	9	Moderate change orders request
9	Type of the client	9	7	5	3	1	3	5	7	9	Size of the client
10	Type of the client	9	7	5	3	1	3	5	7	9	Experience of the client

Appendix F: Software Output

Output Of Ism Software



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A2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1
A3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
A4	1	1	1	1	1	1	1	1	1	0	0	1	0	0	0	1	1
A5	1	1	1	1	1	1	1	1	1	0	0	1	0	0	0	1	1
A6	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	1	1
A7	1	1	1	1	1	1	1	1	1	0	0	1	0	0	0	1	1
A8	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	1	1
A9	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1
A10	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0	1	1
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A19	1	1	1	1	1	1	1	1	1	0	0	1	0	0	0	1	1
A20	1	1	1	1	0	1	1	1	1	0	0	1	1	1	0	1	1
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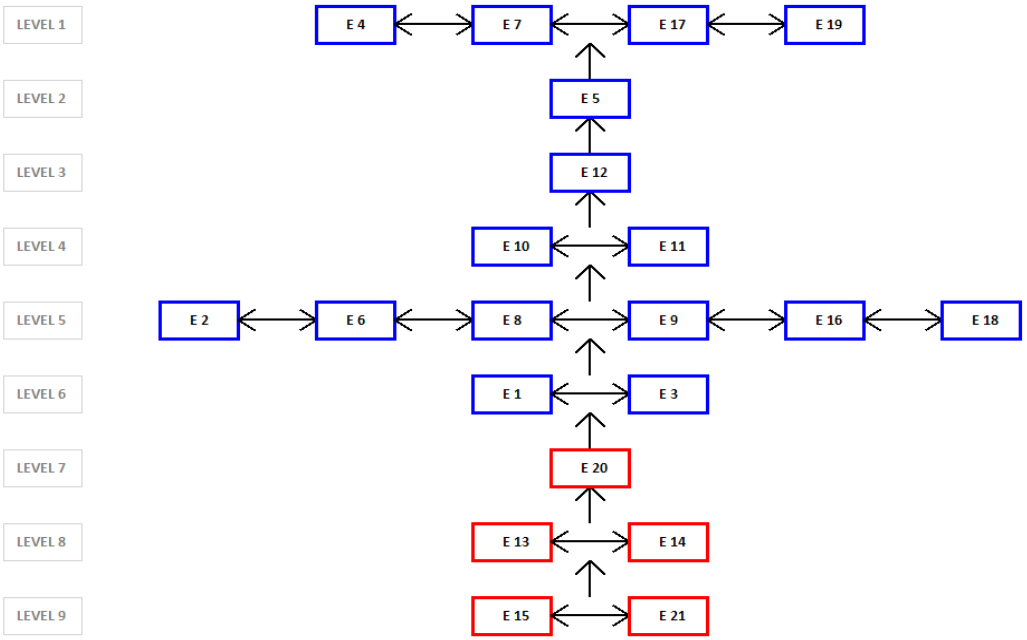
LEVEL 1
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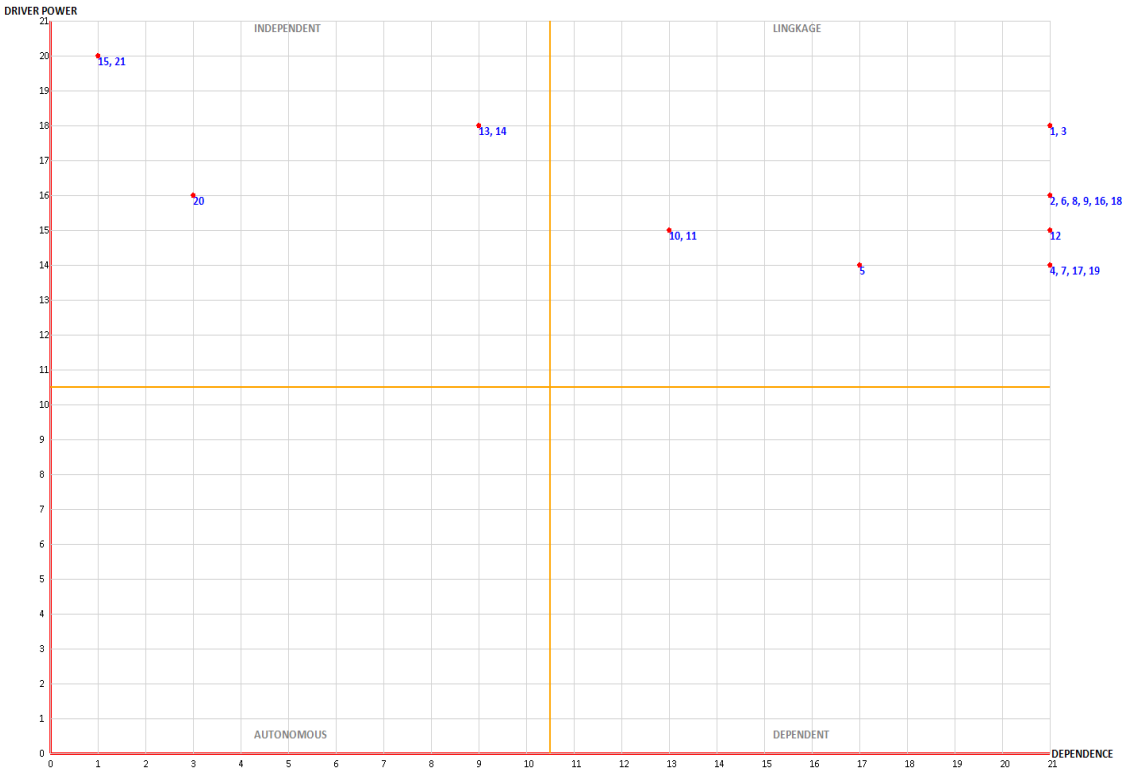
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INDEPENDENT
LINGKAGE
AUTONOMOUS
DEPENDENT
DEPENDENCE
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10, 11
12
5
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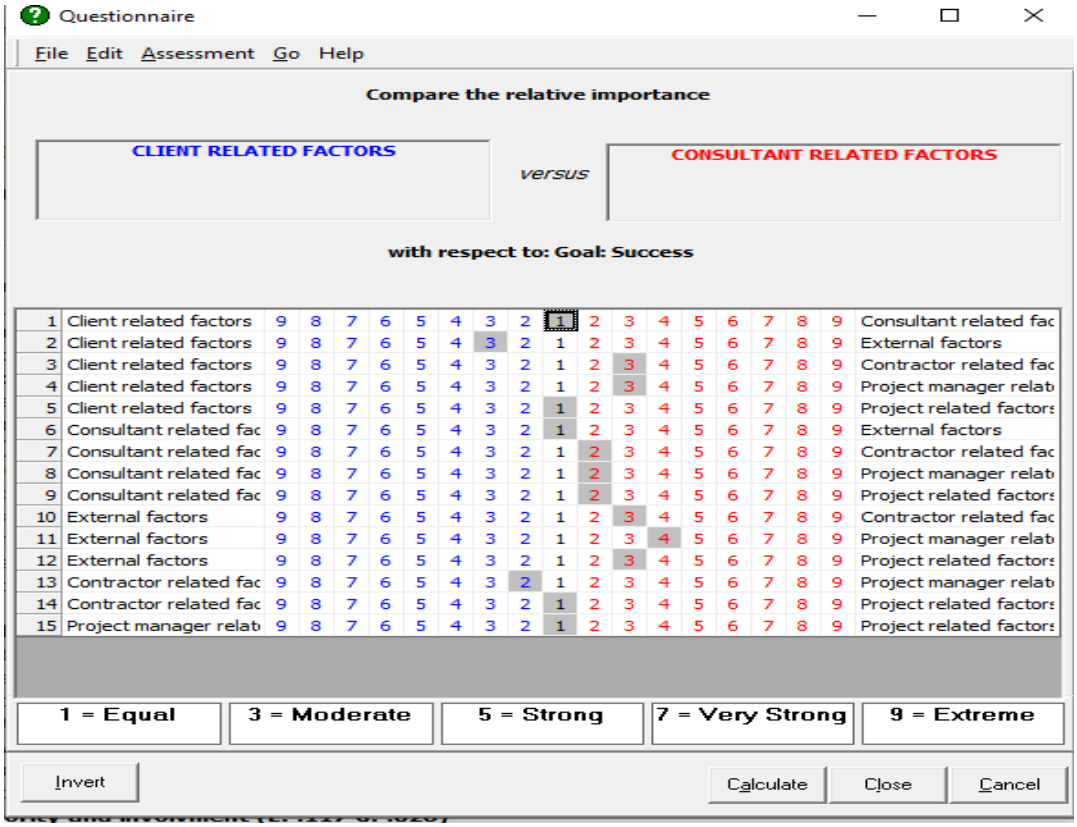
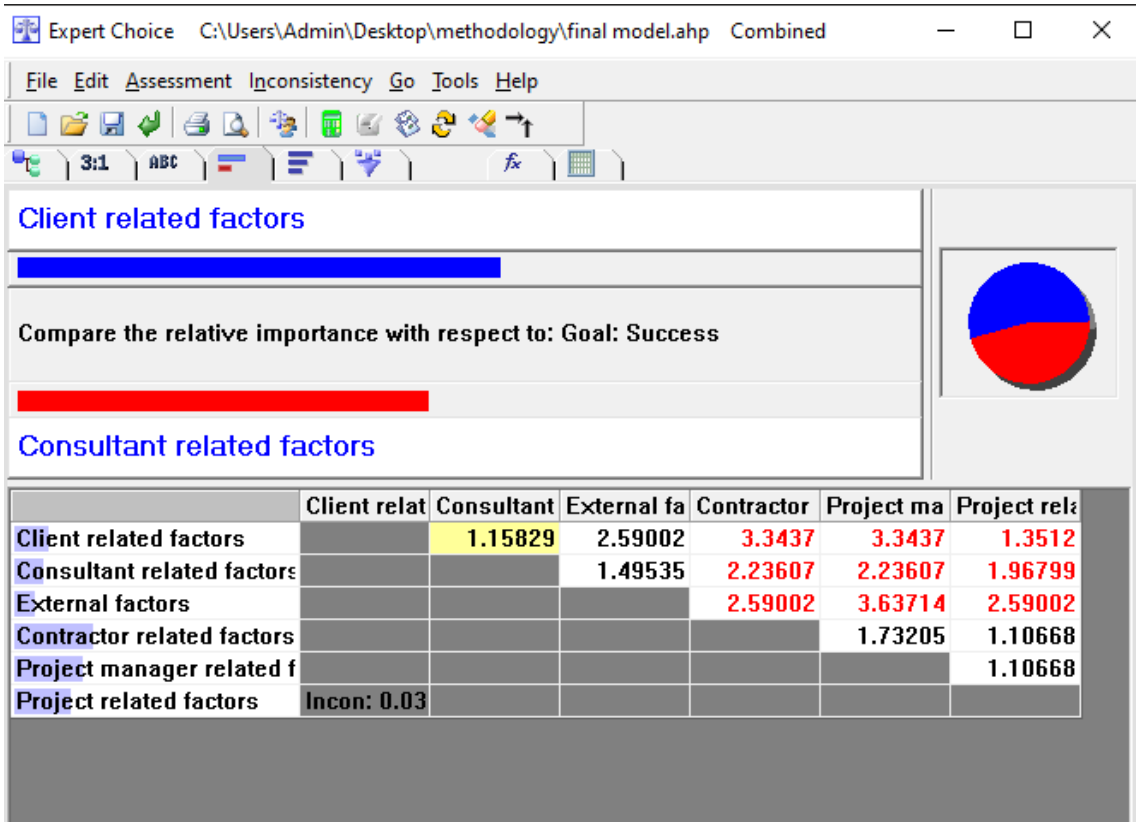
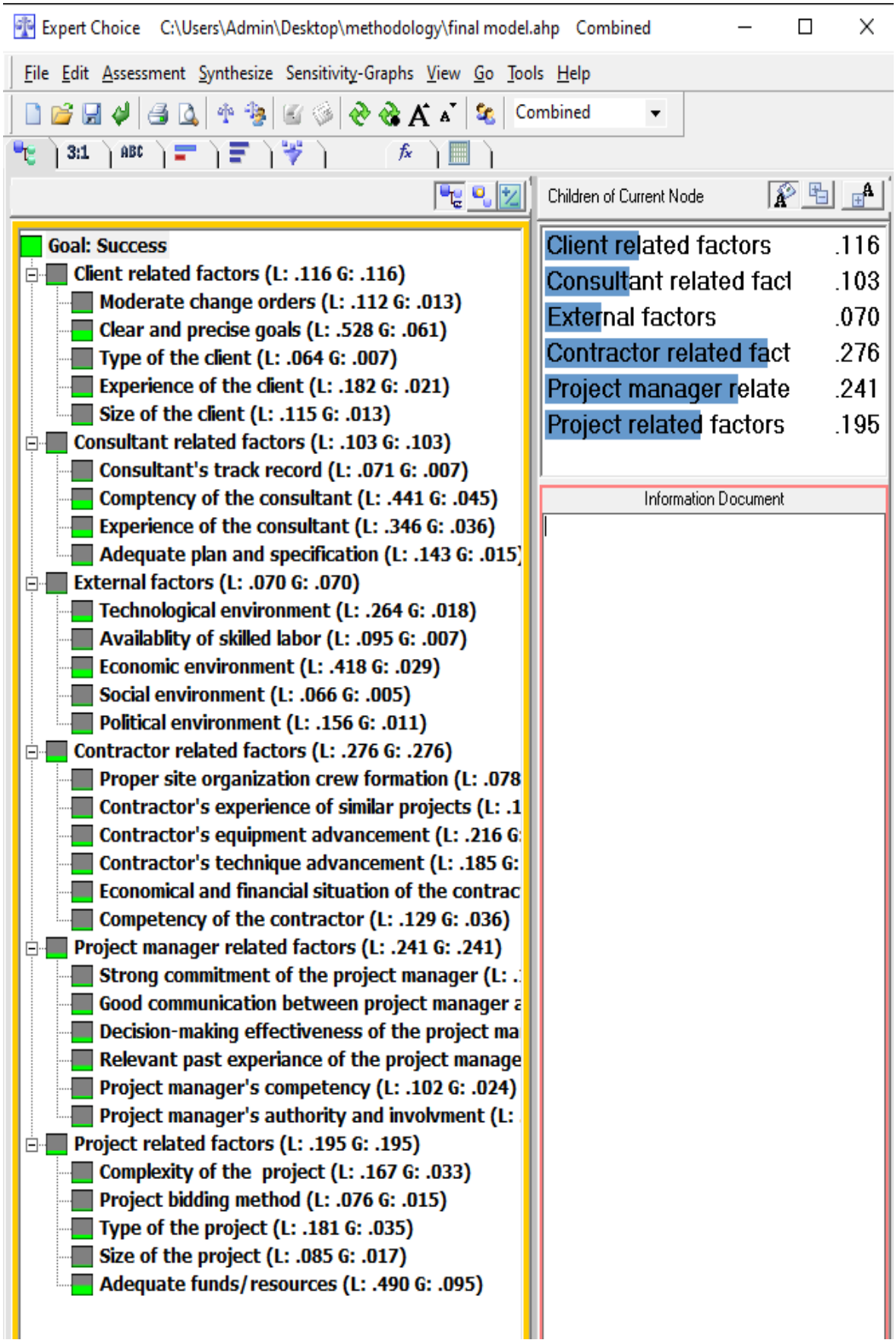
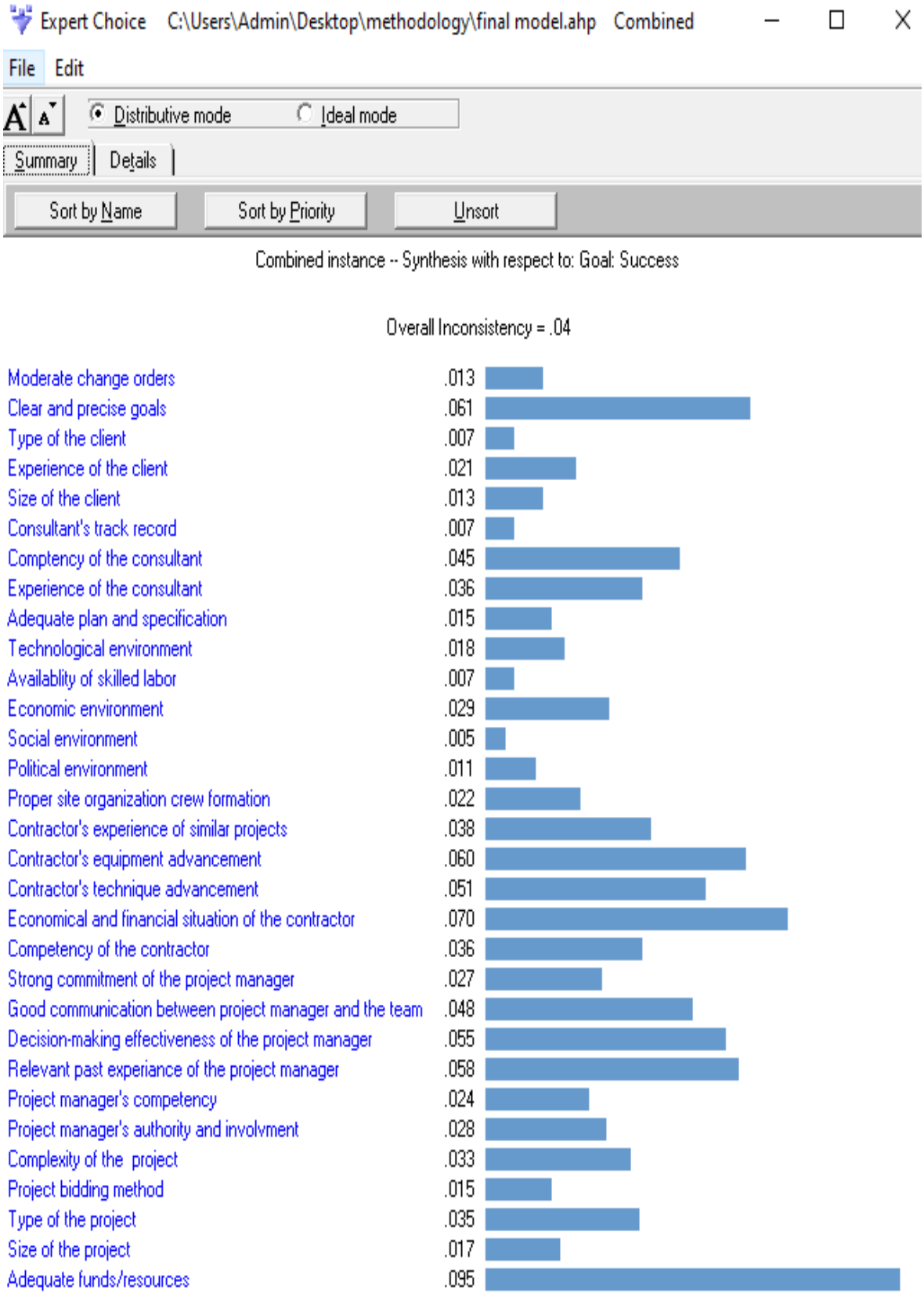
Output Expert Choice






Expert Choice C:\Users\Admin\Desktop\methodology\final model.ahp Combined
File Edit Assessment Synthesize Sensitivity-Graphs View Go Tools Help
Combined
Children of Current Node
Client related factors .116
Consultant related facl .103
External factors .070
Contractor related fact .276
Project manager relate .241
Project related factors .195
Information Document
Goal: Success
Client related factors (L: .116 G: .116)
Moderate change orders (L: .112 G: .013)
Clear and precise goals (L: .528 G: .061)
Type of the client (L: .064 G: .007)
Experience of the client (L: .182 G: .021)
Size of the client (L: .115 G: .013)
Consultant related factors (L: .103 G: .103)
Consultant's track record (L: .071 G: .007)
Comptency of the consultant (L: .441 G: .045)
Experience of the consultant (L: .346 G: .036)
Adequate plan and specification (L: .143 G: .015)
External factors (L: .070 G: .070)
Technological environment (L: .264 G: .018)
Availablity of skilled labor (L: .095 G: .007)
Economic environment (L: .418 G: .029)
Social environment (L: .066 G: .005)
Political environment (L: .156 G: .011)
Contractor related factors (L: .276 G: .276)
Proper site organization crew formation (L: .078
Contractor's experience of similar projects (L: .1
Contractor's equipment advancement (L: .216 G:
Contractor's technique advancement (L: .185 G:
Economical and financial situation of the contrac
Competency of the contractor (L: .129 G: .036)
Project manager related factors (L: .241 G: .241)
Strong commitment of the project manager (L:
Good communication between project manager a
Decision-making effectiveness of the project ma
Relevant past experiance of the project manage
Project manager's competency (L: .102 G: .024)
Project manager's authority and involvment (L:
Project related factors (L: .195 G: .195)
Complexity of the project (L: .167 G: .033)
Project bidding method (L: .076 G: .015)
Type of the project (L: .181 G: .035)
Size of the project (L: .085 G: .017)
Adequate funds/resources (L: .490 G: .095)


Expert Choice C:\Users\Admin\Desktop\methodology\final model.ahp Combined
File Edit
Distributive mode
Ideal mode
Summary
Details
Sort by Name
Sort by Priority
Unsort
Combined instance -- Synthesis with respect to: Goal: Success
Overall Inconsistency = .04
Moderate change orders .013
Clear and precise goals .061
Type of the client .007
Experience of the client .021
Size of the client .013
Consultant's track record .007
Comptency of the consultant .045
Experience of the consultant .036
Adequate plan and specification .015
Technological environment .018
Availablity of skilled labor .007
Economic environment .029
Social environment .005
Political environment .011
Proper site organization crew formation .022
Contractor's experience of similar projects .038
Contractor's equipment advancement .060
Contractor's technique advancement .051
Economical and financial situation of the contractor .070
Competency of the contractor .036
Strong commitment of the project manager .027
Good communication between project manager and the team .048
Decision-making effectiveness of the project manager .055
Relevant past experiance of the project manager .058
Project manager's competency .024
Project manager's authority and involvment .028
Complexity of the project .033
Project bidding method .015
Type of the project .035
Size of the project .017
Adequate funds/resources .095

Output of SPSS

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GET
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   /PRINT=SPEARMAN TWOTAIL NOSIG
   /MISSING=PAIRWISE.
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Nonparametric Correlations

[DataSet1] C:\Users\Admin\Documents\UntitlJJJJed1.sav

Correlations

INFLUENCE				IMPORTANCE
Spearman's rho	INFLUENCE	Correlation Coefficient	1.000	-.197
		Sig. (2-tailed)	.	.393
		N	21	21
	IMPORTANCE	Correlation Coefficient	-.197	1.000
		Sig. (2-tailed)	.393	.
		N	21	21

Scale: bisrat cronbach

Case Processing Summary

		N	%
Cases	Valid	51	100.0
	Excluded	0	.0
	Total	51	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.954	.929	127