Identifying critical success factors for construction projects in Saudi Arabia

Shabir Ahmad\textsuperscript{1}, Faisal Aftab\textsuperscript{2}, Tarig Eltayeb\textsuperscript{2}, and Kamran Siddiqui\textsuperscript{2,*}

\textsuperscript{1}Al Yamama University, 13541 Riyadh, Saudi Arabia
\textsuperscript{2}Imam Abdulrahman Bin Faisal University, 34212 Dammam, Saudi Arabia

Abstract. The construction projects of process industry plants are complex due to the involvement of numerous stakeholders and uncertainty in environmental factors. The internal and external factors affecting the successful execution of the projects vary across industries and countries. It is vital to identify the critical factors for a geographic region and devise the appropriate strategies for the successful execution of the projects. This study aims to identify the critical success factors for construction projects in Saudi Arabia. To achieve the objective, data collected through questionnaire surveys from 342 project managers, directors, engineers, staff, and construction directors were analyzed in SPSS. The findings showed that construction industry projects in Saudi Arabia are usually constrained by five major factors including the project manager’s qualification and experience, project management practices, timely availability of skilled manpower and equipment, clarity of project definition and scope, and weather conditions. The findings imply that Saudi construction firms need to recruit professionally qualified project managers, establish project management office (PMO), revisit supply chain strategies, and provide alternate working hours during tough weather conditions. Further implications, recommendations, and future research directions are discussed in the end.

1 Introduction

Due to the nature of the process industry and uncertainties in technology, design, engineering, operations, maintenance, location, and other environmental factors, the construction of process plants is complex [1]. The project contractor is primarily responsible for project execution and providing the needed financial, human, and material resources. The completed projects of process industry plants play a vital role in national economic development and growth and help nations in achieving the vision. As indicated by [2], development and contracting organizations will confront various issues in response to the deviations in completing the project within cost, time, and quality. The triple constraints in the construction industry are particularly important [3]. The construction industry fundamentally contributes to economic development since it has economic, social, financial, and political repercussions. The future climate of the development and contracting business should be essentially changed

\* Corresponding author: kasiddiqui@iau.edu.sa
from a late venture situated environment because of modern and business changes. In this way, a movement in accentuation from venture accomplishment to corporate achievement must be inspected for development associations to contend in regularly evolving commercial centers.

While contributing to national economic development, the construction industry deals with numerous environmental factors and forces that either positively or negatively impact the successful execution of the project. These factors vary from one country to another due to the differences in culture, political economy, and legal systems. The literature on factors affecting project success is very rich and scholars from various geographical regions have significantly contributed to the body of knowledge. However, when it comes to the middle eastern region and specifically Saudi Arabia, the literature lacks any significant empirical evidence in this field. Apart from being the center of the Islamic world and possessing a rich heritage, and centuries-old civilization, Saudi Arabia is at the crossroads of modern economic development [4]. Vision 2030 of Saudi Arabia primarily aims for a paradigm shift from an oil-dependent economy to an industrial-based economy [5]. Recently, the country has witnessed rapid growth in all major sectors including the construction industry. Consequently, many new projects were initiated. While some projects are completed and others will be completed in the near or far future, it is important to identify the critical factors impacting the successful implementation of these projects.

This study endeavors to fill this gap by investigating the critical success factors for construction projects of process industry plants in the context of Saudi Arabia. The findings will not only help existing local firms but also international firms. Saudi Arabia has recently reduced the trade and investment barriers because of economic reforms under Vision2030, many multinationals are willing to enter the country.

2 Literature review

Construction work is dynamic by nature resulting in growing reservations in expertise, funds, and development processes. In recent times, process industries projects are becoming much more multifaceted and need careful and integrated process management. Research on the basic and key success elements is measured to be a source to enhance the productivity of the work undertaken and to accomplish project objectives [6]. The critical success factors are parts of administrative activity which is crucial to its future achievement. Critical success factors are any of the parts of a business that are identified as basic for successful objectives. In the extant literature a total of 87 critical success factors have been identified in areas, for example, project administration, procurement administration, customer relationship, outline group works, task administration, and contractual workers.

The identification and consolidation of the critical factors are sometimes similar or quite different across industries and countries. [7] identified the following as the most critical factors: (i) a well-ordered, organized project team, plan, design, build and operate the facility; (ii) agreements that authorize and stimulate the various subject matter experts to behave and act as one team without conflicts of self-interest and contrary aims. (iii) design, execution, and operation of the same type of plants or organizations; and (iv) coordinated and upgraded measurements from the proprietor, outline group, development, and contracting association. Whereas, [8] claimed that attributes under critical factors that can impact the success of a project encompass proper communication, control tools, reaction abilities, planning effort, organization assembly, safety and quality assurance package, supervision of subcontractor’s works, and overall decision-making abilities. Concerning procurement-related factors, they are vital in the achievement of construction projects. These factors comprise methods used in selecting the design team, and contractor as well as the method implemented in selecting the project team [9]. Other factors that play an important role in client-related factors include
client competency, experience, and knowledge. Concerning contractor qualifications, numerous factors have been identified in the existing literature including previous knowledge, work proposal, job volume, certification, skilled manpower, project scheduling, and project bidding [10]. Delays in the project completion period and increases in the cost of construction projects have been thoroughly connected to specifications and contractor’s qualifications such as financial, and technical, experience [11].

Another significant factor playing important role in the development process is the design team-related factors. These issues and their contribution commence from the beginning till the accomplishment of the construction project [8]. Further key factors related to the design team consist of planning complications, team members’ qualifications, experience, and delays in generating the documents. The key success factors related to project managers include commitment, experience, team-building skills, and power [12]. [13] emphasized on project environment which entails all external factors that will influence the construction process such as community, governmental and regulatory systems. [14] categorized factors related to the working environment into different types: Personal factors, work conditions, project characteristics, climate, and administrative factors. Other elements such as materials, labor, and productivity also have significant role in successful execution of the construction projects. Likewise, Materials quality and accessibility can affect critically the project's success.

External factors also have a great influence on the success of any project. These elements included the type of business, facility owner familiarity with execution techniques, and level of financial growth. Other than that severe weather conditions, the act of God, price fluctuations, the slow process of a building permit, neighborhood problems, unanticipated site situations, and civil disruptions should be taken into consideration to avoid any problems within the construction project. Most of the existing literature on critical success factors is focused on projects in general. Literature on industrial projects is very scarce which creates the need for further investigations. In addition, this area of research is unexplored in Saudi Arabia. Therefore, this study aims to fill this gap in general as well as in a country-specific context.

3 Research method

This research employed a quantitative research method. The population consists of various professionals directly related to project organization in the construction industry of process plants in Saudi Arabia. The participants included project engineers, project staff, project managers, construction managers, construction directors, and project directors. A questionnaire survey strategy was employed to capture the participants’ responses. The questionnaire was developed following [15] guidelines. The questionnaire contained seven independent and one dependent variable. The measurement scales of independent variables were adopted from [16] and the dependent variable from [17]. A five-point Likert scale was used to capture the response on the significance or insignificance of each of the factors. A total of 750 self-administered questionnaires developed in Google Forms were emailed to the participants. Of these 368 were received, yielding a response rate of 49%. After initial screening 26 incomplete questionnaires were excluded, leaving the final dataset of 342. The data were analyzed in SPSS for factor analysis, validity and reliability of measurement scales, and Relative Index (RI). RI is a method used to calculate the Index of significance for each question (which is one of the factors) of the survey.

4 Result and discussions
4.1 Descriptive Statistics

The demographic profile of participants included 92% male and 8% female, which is consistent with the gender composition of the labor force in the country. Around 40% of participants were aged between 25-35 years, followed by 32% between 36-45, 24% aged between 45-55 years, 3% below 25 years, and 2% above 55 years of age. For participants' qualifications, most respondents (39%) were a Bachelor of Engineering (BE), followed by 32% with having BSc degree, 22% had a Master of Engineering (ME), and 7% were with MSc degree. The sample included 36% project engineers, 26% project staff, 20% project managers, 11% construction managers, 4% construction directors, and 3% of project directors. Most respondents (55%) had 6 to 15 years of experience in project management.

4.2 Validity and Reliability of the Variables

Cronbach's alpha was used to ensure the measurement scales' reliability. All of the variables had values greater than 0.5 and ranged between 0.531 and 0.912, indicating higher reliability of the variables' measurement scales. To determine the validity of the variables, a confirmatory factor analysis (CFA) was performed. CFA was performed with a higher threshold value of 0.70 to ensure that the measurement scale of each variable is valid. All of the items successfully loaded to their respective variables above the threshold value of 0.723 to 0.891.

4.3 Assessment of Critical Success Factors

As explained in the literature review, the success factors for projects were classified into 7 broader categories or independent variables. Each category includes certain key success factors or in other words items that measure the variable. These categories include project management with 3 factors, procurement with 14 factors, clients with 17 factors, design team with 8 factors, contractors with 11 factors, project manager with 16 factors, and work environment with factors. In total, these 87 factors were analyzed for RI significance and Significance Index along with an observation of mean and mode values. As shown in Table 1 the value of RI significance ranges between 0 and 1. Based on the RI range, a significance index was created from 1 to 5, where 1 represents highly insignificant and 5 represents highly significant. Based on the analysis, out of 87, the top 15 most critical success factors for construction projects in the context of Saudi Arabia are presented in Table 2. The category of each factor is also identified in Table 2.

<table>
<thead>
<tr>
<th>RI Range</th>
<th>Significance Index</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.26 - 0.40</td>
<td>1</td>
<td>Highly Insignificant</td>
</tr>
<tr>
<td>&gt;0.41 - 0.55</td>
<td>2</td>
<td>Moderately Insignificant</td>
</tr>
<tr>
<td>&gt;0.56 - 0.70</td>
<td>3</td>
<td>Neutral</td>
</tr>
<tr>
<td>&gt;0.71 - 0.85</td>
<td>4</td>
<td>Moderately Significant</td>
</tr>
<tr>
<td>&gt;0.86 - 1.00</td>
<td>5</td>
<td>Highly Significant</td>
</tr>
</tbody>
</table>
The analysis revealed that the project manager’s qualification and experience, the coordination and relationship of the project manager with the client, and the timely availability of skilled manpower resources are the topmost critical success factors with the highest Relative Index (RI) significance in Saudi Arabia (See Table 2). These three factors are interrelated and correspond to the scarcity of skilled labor in the country. The extant literature contends that the project manager’s competency plays a highly critical role in project success. A project manager is a highly visible person who is responsible for: completing the project activities in order and on time and within the budget and quality standards; and providing needed motivation, direction, and information to the project team. Saudi Arabia has faced a shortage of skilled workforce for many decades. To overcome this shortage, Saudi Arabia recruited millions of expatriate workers in the past decades. However, in recent years the government initiated a nationalist campaign, called Saudization, to reduce the dependence on expatriate workers and provide more jobs to the citizens. A significant number of expatriates left the country which created a shortage of competent workforce. At the same time, the government initiated numerous skills development programs for the locals, however, it will take its due course to fulfill the market needs of a competent workforce. This shows the scarcity of professionally qualified and experienced project managers could be one of the reasons that lead to a lack of effective coordination between the project manager and client firms. Thus, the government needs to evaluate its policies; either to speed up skills development programs or allow the recruitment of expatriates’ project-related workforce until the local workforce is qualified and trained.

Table 2. Significant Project Success Factors with Category.

<table>
<thead>
<tr>
<th>Project Success Factors</th>
<th>(RI) Significance</th>
<th>Significance Index</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project manager experience &amp; qualification</td>
<td>0.91</td>
<td>5</td>
<td>Project Manager</td>
</tr>
<tr>
<td>Coordination and relationship of project manager with client</td>
<td>0.90</td>
<td>5</td>
<td>Project Manager</td>
</tr>
<tr>
<td>Timely availability of skilled manpower resources</td>
<td>0.90</td>
<td>5</td>
<td>Contractor</td>
</tr>
<tr>
<td>Contractor experience</td>
<td>0.89</td>
<td>5</td>
<td>Contractor</td>
</tr>
<tr>
<td>Timely availability of machine/equipment resources</td>
<td>0.89</td>
<td>5</td>
<td>Contractor</td>
</tr>
<tr>
<td>Clear and detailed definition of project scope and objectives</td>
<td>0.89</td>
<td>5</td>
<td>Client</td>
</tr>
<tr>
<td>Clients’ ability to make decisions</td>
<td>0.89</td>
<td>5</td>
<td>Client</td>
</tr>
<tr>
<td>Effective communication system</td>
<td>0.89</td>
<td>4</td>
<td>Project Management</td>
</tr>
<tr>
<td>Planning &amp; scheduling efforts</td>
<td>0.85</td>
<td>4</td>
<td>Project Management</td>
</tr>
<tr>
<td>Shipment location - Local</td>
<td>0.85</td>
<td>4</td>
<td>Procurement</td>
</tr>
<tr>
<td>Design team experience</td>
<td>0.85</td>
<td>4</td>
<td>Design Team</td>
</tr>
<tr>
<td>Delays in generating design documents</td>
<td>0.84</td>
<td>4</td>
<td>Design Team</td>
</tr>
<tr>
<td>Delivery point of supplier – Local</td>
<td>0.84</td>
<td>4</td>
<td>Procurement</td>
</tr>
<tr>
<td>Shipment location – Overseas</td>
<td>0.84</td>
<td>4</td>
<td>Procurement</td>
</tr>
<tr>
<td>Weather conditions</td>
<td>0.79</td>
<td>4</td>
<td>Work Environment</td>
</tr>
</tbody>
</table>

The success factors at the second level with an RI significance of 0.89 include contractor experience, timely availability of machine/equipment resources, clear and detailed definition
of project objectives and scope, client's ability to make decisions, and effective communication system. The first three factors are related to the contractor’s competency and the last two belong to the client and project management category. Without a doubt, the firm's ability to execute the project in terms of its experience, provide human and material resources, and clearly define the scope and objectives of the project following the client's requirements is critical to the project's success or failure. The existing literature lists these three factors as the primary causes of project failure. For instance, According to the famous Operations Management textbook by [19] the following are the primary causes of project failure: poor project definition and objectives, a lack of relevant data, a lack of technical know-how, political factors, unproven design modifications, insufficient inspection and quality assurance, the invisibility of project management, poor organization and personnel, imperfect information handling, inadequate risk management, a lack of team spirit, and a lack of maintenance.

At the third level, the success factors with an RI significance of 0.89 include planning and scheduling, local and overseas shipment locations, design team experience, delays in generating design documents, and delivery points of the local suppliers. These factors are mainly related to procurement and design team categories. Whereas planning and scheduling correspond to the contractor’s competency to manage the project. The lack of a proper project management organization such project management office (PMO) usually leads to ineffective management of the projects. Project Management Institute, the prime global institution for project management, highly recommends that firms establish a PMO and hire Project Management Professional (PMP) project managers for effective project management. Concerning the local and overseas procurement factors that adversely delay the project progress, Saudi firms need to re-evaluate their suppliers and supply chain strategies. For the local suppliers: to ensure timely deliveries and quality material and resources, it is recommended to choose a few of the most competent suppliers and make a long-term partnership with them instead of many suppliers or bidding strategies. For overseas shipments: Saudi firms may outsource the logistics and supplies to a professional EMC (Export Management Company) to capitalize on EMC’s expertise, reduce the cost and ensure timely deliveries of shipments.

At the fourth level, the local weather conditions with an RI significance of 0.79 were identified as one of the critical success factors. The weather conditions in Saudi Arabia are very much related to construction projects in Saudi Arabia because the outside temperature in the urban cities reaches 50°C or above during summer which is an intolerable level for human beings. Saudi Health and Safety Regulations prohibit working under the sun from 12 to 03 Pm from June to September. A big part of the construction work requires workers to work outdoors directly facing the sun. Though it impedes the project's progress, it is for workers’ safety apart from being the law of the land. The temperature falls to a tolerable level suitable for outside during the evening or early morning. Most companies reorganize their work hours to start early in the morning and finish before noon or prefer to begin in the evening till late in the night.

5 Conclusion and implications

The objective of this study was to identify the critical success factors for construction projects in the context of Saudi Arabia. The population of this study consists of various professionals directly related to project organization in the construction industry of process plants in Saudi Arabia to achieve the objective, data were collected from 342 project managers, directors, engineers, staff, and construction directors using questionnaires surveys, and data were analyzed in SPSS. Cronbach alpha was used to ensure the measurement scales' reliability (the values ranged between 0.531 and 0.912 reflecting high reliability). CFA was used to ensure
validity. The factor loading values ranged from 0.723 to 0.891, indicating that the scales were highly valid. The existing literature has identified 87 various factors that impact project execution. In this study, 87 factors were classified into 7 broader categories and were analyzed for Relative Index (RI) significance. The results revealed that construction industry projects in Saudi Arabia are usually constrained by five major factors including the project manager’s qualification and experience, project management practices, timely availability of skilled manpower and equipment, clarity of project definition and scope, and weather conditions. The findings imply that Saudi construction firms need to focus on recruiting professionally qualified project managers, establish project management office (PMO), revisit supply chain strategies, and provide alternate working hours during tough weather conditions.

6 Limitations and future research directions

The scope of this research is limited to construction projects in the process industry in Saudi Arabia. Future research can explore key success factors for projects in other industries in Saudi Arabia. The study participants included mostly internal stakeholders directly related to the project such as project engineers, project staff, project managers, construction managers, construction directors, and project directors. Future researchers may include collecting data from external stakeholders such as the concerned government agencies, suppliers, vendors, clients, and social groups.

References