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Risk Assessment of Construction Projects in Saudi Arabia

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***Abstract*— In the present study, the critical risk factors (CRFs) of Saudi Arabia construction projects published in literature are assessed for risk probability or possibility of occurrence of risk and perceived impact of the risk factor to determine the degree of risk. For risk factor assessment, the primary data is acquired through a questionnaire survey of professionals and experts of construction projects of different regions in Saudi Arabia. The proposed risk assessment approach of construction CRFs in this work will help in controlling the risk in the construction projects of Saudi Arabia. It is concluded from the study that the highest degree risk factor for Saudi Arabia construction project is "the awarding the construction projects contract to poor construction knowledge and unexperienced contractor".**

Index Terms: Critical Risk Factors, Construction Projects, Risk Management, Project Management.

I. INTRODUCTION

The infrastructure in Saudi Arabia is experiencing rapid development through the greater participation of the private and the government investment in the sectors of housing, transport and energy, and respective related industries [1]. The construction industry must be prepared to manage contractual obligations, regulatory protocols, and project financing while keeping pace with technology changes and increasing quality demands of a more sophisticated population. The construction industry in KSA is facing with different types of risks of varied nature that lead to poor performance, increase of expenses, and tardiness of the delivery and even failure of the project. The processes of conducting risk management planning, identification, analysis, response planning, and controlling risk on a project is known as risk management [2]. The risk management as part of project management is extremely important in achieving project objectives of time, cost, quality, improved health and safety and no disputes. Risk management is a proactive rather than a reactive concept. Changes in technology and more sophisticated clients' requirements attract more risks in construction projects which call for formal risk management process. Failure to make a timely assessment of risks and their impact on project objectives (e.g., project duration and cost) can hinder project success [3]. Akintoye and MacLeod [4] found that risk analysis and management in construction depend mainly on intuition, judgment and experience. Project risk can be defined as an uncertain event that leads to failing to achieve at least one project objective [5]. The researcher also defined risk in others ways such as risk is the probability of losses in a project which hinders objectives in terms of economic loss or gain, physical damage or delay [6]. The various construction projects risk can be categorized depending on risk nature as technical, social, construction, economic, legal, financial, natural, commercial, logistics and political risks. The construction projects risk can be classified depending on organization control and management process as internal and external risks.

Saudi Arabia has an alarming number of unsuccessful construction projects and need an urgent attention [7]. The failures of projects are nearly at every level and in every stage of the process i.e., design, planning, management, execution, commissioning [8]. In Saudi Arabia, construction projects face major weaknesses owing to a lack of experience, poor execution processes/quality control, unskilled human resources, and poor project management practices [9].

In the present study, the ten most critical risk factors (CRFs) of Saudi Arabia construction projects published in literature are assessed for risk probability or possibility of occurrence of risk and perceived impact of the risk factor to determine the degree of risk. For risk factor assessment, the primary data is acquired through a questionnaire survey of professionals and experts of construction projects of different regions in Saudi Arabia.

II. METHODOLOGY

The descriptive methodology has been used in the present work for project success factor impact analysis. In the research study, an extensive review of the literature on construction projects was conducted to identify and understand the various risk factors associated with them. After a detailed review, the ten most critical risk factor are identified as shown in Table 1.

Table 1: Identified CRFs of KSA Construction Projects

Risk factors	References
Contractors' poor knowledge and experience (CPK)	[10], [11-12], [13], [14-15], [16], [17]
Absence of management of change orders (AMC)	[18], [19], [13], [17], [20],

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Risk factors	References
Incomplete & faulty design and specifications (IFD)	[21], [12], [13], [14-15], [16], [17]
Improper Coordination between Teams (ICT)	[21], [18], [11], [15], [16], [17]
Inadequate Managerial skills and unavailability of project management establishments (IMS)	[21], [11-12], [22], [17]
Unavailability of skilled and unskilled labor due to unfavorable conditions (USUL)	[21], [12], [14-15], [22], [17],
Delays in Payment (DiP)	[18], [13], [20], [14-15], [17],
Poor safety procedures (PSP)	[21], [13], [19], [20], [22], [16]
Non-implementation of the terms of contracts by clients (NTC)	[18], [20], [22], [16]
Improper & inadequate site survey (IIS)	[21], [11-12], [13], [20], [14], [22], [16],

The study adopted a quantitative approach for the assessment of project risks factors of construction industry of the Saudi Arabia and obtained the views of more than hundred construction industry professional to the issues of risks impacting on the variation of objectives for construction projects success. The questionnaire is the main data collection procedure. The questionnaires are classified into two main parts. The first part is general information of professionals. The second part of the questionnaire includes a list of already identified factors that the respondents shall score the risk probability or possibility of occurrence of risk and perceived impact of the risk factor to find the degree of risk. Two questions are posed for each factor: First-question, how much is the possibility of occurrence of this risk factor in the construction project? Second- question If this risk factor was occurred, what will be its impact on realization of the project objectives? The probability of risk occurrence is classified in three parts, as high, medium and low possibility of occurrence. The risk impact on project is also classified into three parts, as high, medium and low impact on project time, cost or performance. Response to this questionnaire gives the measuring scale, which makes the retrieved data suitable for statistical analysis techniques [23] such as Risk Probability, Risk Impact, Degree of risk and Spearman rank correlation coefficient.

Risk Probability (P) or Risk Impact (I) = $\Sigma a(n/N)$ (1)

where a is the constant expressing weighting given to each response (ranges from 1 for low probability or low impact, 3 for medium probability or medium impact, up to 5 for high probability or high impact), n is the frequency of the responses, and N is total number of responses. Degree of risk (R) each risk factor is calculated as a function of both risk probability (P)and risk impact (I) [24].

Degree of risk (R) = (P x I) (2)

The risk factors are defined by four categories based on degree of risk (R), Category I (R value, 15-25); Category II (R value, 9 - < 15); Category III (R value, 5 - < 9); Category IV (R value, 1 - < 5). The degree of risk for the top ten most CRFs, are calculated and presented in Table 3.

III. RESULTS AND DISCUSSION

A. Results

The degree of risk, function of both risk probability (P) and risk impact (I), for the ten critical risk factors (CRFs), identified through literature survey, are calculated and presented in Table 2.

Table 2: Risk assessment of CRFs in Construction Projects using Degree of Risk (R)

Risk Assessment of Construction Projects Risk Factors				Overall Rank
Risk Factors	P	I	R= PxI	
CPK	3.83	4.01	15.358	1 (I)
AMC	3.88	3.95	15.326	2 (I)
IFD	3.88	3.69	14.317	3 (II)
ICT	3.58	3.73	13.353	4 (II)
IMS	3.67	3.57	13.102	5 (II)
USUL	3.67	3.57	13.102	6 (II)
DiP	3.51	3.5	12.285	7 (II)
PSP	3.45	3.52	12.144	8 (II)
NTC	3.36	3.49	11.727	9 (II)
IIS	3.44	3.4	11.696	10 (II)

Spearman's coefficient of correlation (ρ), is used to determine the level of either agreement or disagreement among the respondents in their judgement of each of the risk factors. Spearman's coefficient of correlation (ρ) value is 0.855 for the considered CRFs. The Spearman's coefficient with high value specifies a positive and durable agreement from the professional in their decisions on each of the risk factors and top ten identified risk factors are reliable for predictive modelling.

B. Discussion

The assessment of risk occurrence probability and impact of identified ten risks on success of construction projects of Saudi Arabia is represented in Table 2. Table ranks the construction project professional's perceptions of risk occurrence and risk impact. From the Table, the mean analysis of the probability of risk occurrence ranges between 3.44 and 3.83, a result which indicates that 'Absence of management of change orders' has a high probability of occurrence and 'non-implementation of the terms of contracts by clients' has low probability of occurrence. The top five of the risk factors identified occurred up to and above the medium level of occurrence (i.e. between 3.0 and 4.0). The others fall between a very low and medium level of occurrence (i.e. between 1.0 and 3.0). Also, the mean analysis

of the impact of risk ranges between 3.4 and 4.01, which indicates that 'Contractors' poor knowledge and experience' has a critical impact and 'Improper & inadequate site survey' has low impact on success of construction projects. The table also examines the construction project professional's perceptions of the 'degree of risk' measurement on success of the projects as expressed in Equation (2). The purpose of risk assessment based on degree of risk, is to classify the risk factors on degree of attention for the success of the project. The 'degree of risk' values of the identified risk factors, determined in Table 6, are range from 11.696 to 15.358. The degree of risk' values suggest that top two identified risk factors i.e., contractors' poor knowledge and experience, absence of management of change orders, are from the high attention risk factors (R values more than 15) and others risk factors need good amount of attention (R values range in 9-15).

IV. CONCLUSION

The Critical Risk Factors (CRFs) of construction projects are very significant for success and projects management. The findings of the study will provide valuable insights for construction managers in assessing and addressing potential risks in building projects. By understanding the identified risks and their potential impact, managers can make informed decisions to mitigate and manage these risks effectively. The construction project management should have an effective process for award of contract to experienced contractor and award of change order in projects to avoid the failure of the projects.

A. Limitations and Suggestions for Future Work

1. The study is limited to the risk factors for building construction projects only, the study could be extended for risk in other type of construction projects of Saudi Arabia.
2. The construction risk factor may be investigated from the project's stakeholder point of view.
3. The construction risk factor assessment may also be extended for the sustainability aspect in construction projects.

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