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The Factors Impacting the Quality of Construction Projects in the Oil and Gas Sector in Saudi Arabia

العوامل المؤثرة على جودة مشاريع البناء في قطاع النفط و الغاز بالمملكة العربية السعودية

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Abstract

This research presents a study conducted to identify the factors that impact the Quality of Construction Projects in the Oil and Gas sectors inside Saudi Arabia during the construction phase of the project life cycle through studying focus groups who was having extensive experience in the Oil and Gas field. The Methodology followed in this research to achieve its objective is a combination of historical data gathered from literature reviews, and a survey targeting an experienced focus group of Construction Project Managers, Construction Engineering Managers, and Professional Technical Construction Lead Engineers.

Introduction

Quality is one of the critical factors in the success of construction projects. Quality of construction projects, as well as project success, can be regarded as the fulfillment of expectations (i.e., the satisfaction) of the project participants (05). Quality of projects is one of the traditional and global measures of project performance. For construction projects, the goal and desire of clients, contractors, and consultants are to ensure that projects are delivered according to acceptable and agreed standards (03). The quality of construction projects is linked with proper quality management in all the phases of the project life cycle. Design and construction are the two important phases of the project life cycle that affect the quality outcome of construction projects significantly (05). Great expenditures of time, money, and resources are wasted each year due to inefficient or non-existent quality levels (01).

The question is “Are those factors that have been identified outside Saudi Arabia in different geographical areas having the same impact on the construction projects inside Saudi Arabia? Especially in Oil and Gas Sector? And What is the highest factor that results in the highest impact on the Quality?”

The Purpose of the Study

The purpose of this paper is to identify the highest factors that impact the Quality of Construction from the literature review in different geographical areas. Then, ranking those factors based on the conducted survey for a focus group of experienced staff working in the construction phase of the projects to identify the highest factors and lowest factors impacting the Quality of construction projects inside Saudi Arabia in the Oil and Gas sector.

Previous Studies

Luai Jraisat, Lana Jreisat, and Christine Hattar (01) found that human resource management, customer satisfaction, and construction-specific factors are factors impacting the quality of construction projects. Albert P.C. Chan and C.M. Tam (02) also identified that the client, the project characteristics, the project environment, Project Team Leaders, project procedures, and project management actions are factors impacting the quality of the projects. Additionally, Ayodeji Oke, Clinton Aigbavboa, and Ernest Dlamini identified several factors such as Poor on-site

supervision, Construction labor skills and induction, Poor planning and scheduling, Involvement of End-User clients, and Assurance with client funding.

The above mentioned factors are identified in the literature review as the highest factors impacting the quality of the projects in several geographical areas outside Saudi Arabia.

The Study aims to verify which of those factors has the highest impact on Saudi Arabia in the Oil and Gas factors as the factors differ in each geographical area.

Research Problem and Significance of the Research

There are different and various factors identified in different geographical areas that impact the quality of the projects in general as well as Construction Projects specifically. However, the highest factors impacting the Projects quality identified in specific numbers of previous literature studies mentioned in the reference of this paper have been used for this research study. The research methodology selected in this research is to survey those factors inside Saudi Arabia through focus groups to identify whether those factors are having an impact on Construction Projects in the Oil and Gas sector or not.

Identified factors using the literature review method are as follows:

Potential Factors		Resources Reference Number			
		01	02	03	04
01	Human Resource Management.	X			
02	Customer Satisfaction.	X			
03	Construction specific factors such as Codes and Standards, Drawings and Specifications, and Constructability of Design.	X			
04	Project management actions of the project team (Managerial Control, level of administrative ability)		X		
05	Client's emphasis on time.		X		
06	Client's emphasis on quality.		X		
07	Effectiveness of construction team leader.		X		
08	Lack of communication among project stakeholders.			X	

09	Unskilled and inexperienced trade subcontractors, sub-suppliers, and consultants.			X	
10	Poor on-site supervision/visitation.			X	
11	Poor planning, scheduling, and monitoring.			X	X
12	Incomplete design drawings at tendering stage.				X
13	Changes in the client's requirements.				X
14	Fluctuation of material cost.				X
15	Financial difficulties faced by the contractors.				X

Research Methodology

The research methodology to obtain the above-mentioned objectives and results by following the below procedures:

- Comprehensive review of previous research to identify the factors impacting the quality of construction projects in different geographical areas.
- Develop a questionnaire survey to collect feedback from focus group consisting of Construction Project Managers, Engineering Managers, and Professional Technical Lead Engineers. The survey aims to collect feedback related to the identified factors in the previous steps.
- Distribute the survey to the focus group consisting of experienced Construction Engineers, Construction Managers, and Construction Engineering Managers. The Targeted Population is 15 Professionals working in the Construction Phase of the Projects related to the Oil and Gas Sector inside Saudi Arabia.
- Analyze the data received from previous steps and determine the level of impact of each factor using statistical Analysis as follows:
 1. Tabulate the responses.
 2. Determining the relative importance of the identified factors using the Relative importance index (RII) method using the following equation:

$$RII = \frac{\sum SR}{W(N)} = \frac{4n_4 + 3n_3 + 2n_2 + 1n_1}{4W}$$

Where:

SR = The scale of each factor based on the participant's judgment (1 to 4) for Relative Importance.

W = The highest Weight, equal to 4

N = The Number of participants

n_4 = Number of responses for Very High

n_3 = Number of responses for High

n_2 = Number of responses for Low

n_1 = Number of responses for Very Low

RII varies from 1 to 0, where a higher value means that the factor is more important.

3. Determining the impact of frequency in the equation resulted from the survey of the identified factors using the Frequency Adjusted Importance Index (FAII) as follows:

- First Calculate the Frequency Index:

$$FI = \frac{\sum SF}{W(N)}$$

Where:

SF = The scale of each factor based on the participant's judgment (1 to 4) for the Frequency factor.

W = The highest Weight, equal to 4

N = The Number of participants

After Calculating the RII and FI Then the frequency-adjusted importance index (FAII) can be obtained using the following equation:

$$FAII = (RII \times FI) \times 100$$

FAII varies from 1 to 0, where a higher value means that the factor is more important.

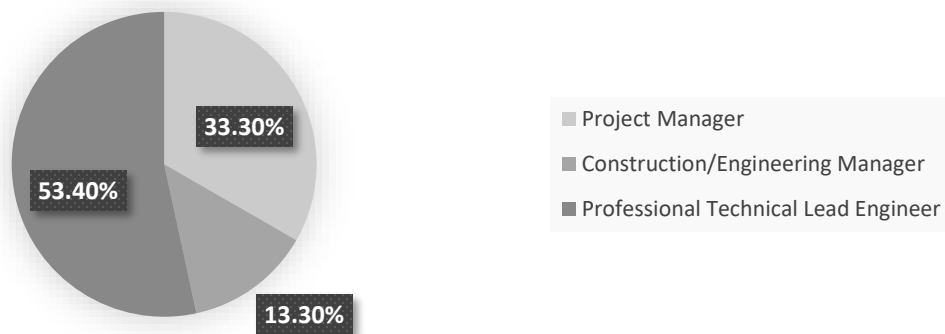
Assessment and Analysis of the Factors Impacting the Quality of the Projects in the Construction Phase.

The Fifteen Factors that have been collected from the literature review have been surveyed using a web Questioner Survey. A total number of 15 responses was gathered from a focus group working on Oil and Gas Projects inside Saudi Arabia during the construction phase.

This Study focuses on obtaining responses from several professionals who are directly working in the construction phase of the project having one of the following roles mentioned in the below table. Also, the Table shows the total number of responses against each roll.

Role	Percentage of Participants
Project Manager	33.3%
Construction/Engineering Manager	13.3%
Professional Technical Lead Engineer	53.4%

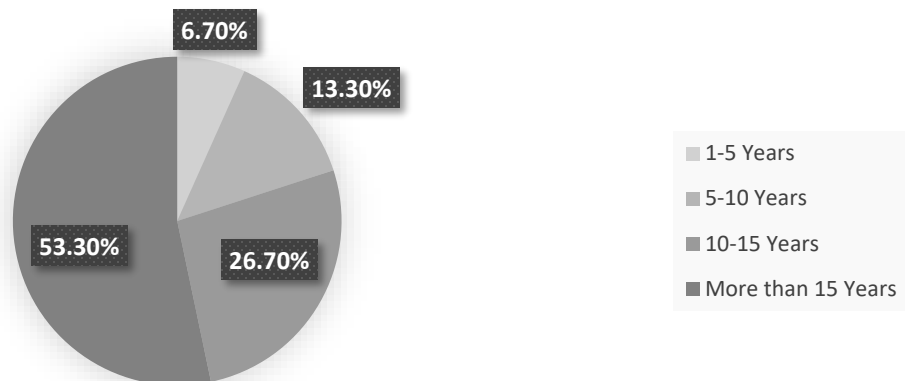
Percentage of Participants



The following table shows the percentage of the participant against the total years of experience.

Years of Experience	Percentage of Participants
1-5 Years	6.7%
5-10 Years	13.3%
10-15 Years	26.7%
More than 15 Years	53.3%

Percentage of Participants



Relative Importance Index (RII)

The following table shows the raw data collected using the survey of the importance level:

Raw Data of the Relative Importance Index (RII)

S/N	Potential Factors	Impact Level				Total Response
		1	2	3	4	
01	Human Resource Management.	0	1	9	5	15
02	Customer Satisfaction.	1	2	8	4	15
03	Construction specific factors such as Codes and Standards, Drawings and Specifications, and Constructability of Design.	0	1	6	8	15
04	Project management actions of the project team (Managerial Control, level of administrative ability)	0	3	7	5	15
05	Client's emphasis on time.	0	1	9	5	15
06	Client's emphasis on quality.	0	0	6	9	15
07	Effectiveness of construction team leader.	0	0	12	3	15
08	Lack of communication among project stakeholders.	1	1	7	6	15
09	Unskilled and inexperienced trade subcontractors, sub-suppliers, and consultants.	1	2	3	9	15
10	Poor on-site supervision/visitation.	1	2	10	2	15
11	Poor planning, scheduling, and monitoring.	0	1	8	6	15
12	Incomplete design drawings at tendering stage.	1	4	6	4	15
13	Changes in the client's requirements.	0	2	11	2	15
14	Fluctuation of material cost.	0	1	13	1	15

15	Financial difficulties faced by the contractors.	0	1	12	2	15
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The following Table shows the ranking of the factors impacting the quality of the construction projects based on the Relative Importance Index:

The Relative Importance Index (RII)

S/N	Potential Factors	RII	Ranking
06	Client's emphasis on quality.	0.6750	01
03	Construction specific factors such as Codes and Standards, Drawings and Specifications, and Constructability of Design.	0.6500	02
09	Unskilled and inexperienced trade subcontractors, sub-suppliers, and consultants.	0.6250	03
11	Poor planning, scheduling, and monitoring.	0.6250	04
01	Human Resource Management.	0.6125	05
05	Client's emphasis on time.	0.6125	06
07	Effectiveness of construction team leader.	0.6000	07
08	Lack of communication among project stakeholders.	0.6000	08
04	Project management actions of the project team (Managerial Control, level of administrative ability)	0.5875	09
15	Financial difficulties faced by the contractors.	0.5750	10
02	Customer Satisfaction.	0.5625	11
13	Changes in the client's requirements.	0.5625	12
14	Fluctuation of material cost.	0.5625	13
10	Poor on-site supervision/visitation.	0.5375	14

12	Incomplete design drawings at tendering stage.	0.5375	15
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Relative Importance Frequency Index (FI)

The following table shows the raw data collected using the survey of the frequency level impact:

Raw Data of the Frequency Index (FI)

S/N	Potential Factors	Impact Level				Total Response
		1	2	3	4	
01	Human Resource Management.	0	2	11	2	15
02	Customer Satisfaction.	0	3	7	5	15
03	Construction specific factors such as Codes and Standards, Drawings and Specifications, and Constructability of Design.	0	4	7	4	15
04	Project management actions of the project team (Managerial Control, level of administrative ability)	1	1	11	2	15
05	Client's emphasis on time.	0	2	9	4	15
06	Client's emphasis on quality.	0	2	6	7	15
07	Effectiveness of construction team leader.	0	4	8	3	15
08	Lack of communication among project stakeholders.	2	2	4	7	15
09	Unskilled and inexperienced trade subcontractors, sub-suppliers, and consultants.	1	6	5	3	15
10	Poor on-site supervision/visitation.	3	6	5	1	15
11	Poor planning, scheduling, and monitoring.	0	4	5	6	15
12	Incomplete design drawings at tendering stage.	0	7	5	3	15

13	Changes in the client's requirements.	0	6	8	1	15
14	Fluctuation of material cost.	1	7	6	1	15
15	Financial difficulties faced by the contractors.	0	6	8	1	15

The following Table shows the ranking of the factors impacting the quality of the construction projects based on the Frequency Index:

The Frequency Index (FI)

S/N	Potential Factors	FI	Ranking
06	Client's emphasis on quality.	0.6250	01
02	Customer Satisfaction.	0.5875	02
05	Client's emphasis on time.	0.5875	03
11	Poor planning, scheduling, and monitoring.	0.5875	04
08	Lack of communication among project stakeholders.	0.5750	05
01	Human Resource Management.	0.5625	06
03	Construction specific factors such as Codes and Standards, Drawings and Specifications, and Constructability of Design.	0.5625	07
04	Project management actions of the project team (Managerial Control, level of administrative ability)	0.5500	08
07	Effectiveness of construction team leader.	0.5500	09
12	Incomplete design drawings at tendering stage.	0.5125	10
09	Unskilled and inexperienced trade subcontractors, sub-suppliers, and consultants.	0.5000	11
13	Changes in the client's requirements.	0.5000	12

15	Financial difficulties faced by the contractors.	0.5000	13
14	Fluctuation of material cost.	0.4625	14
10	Poor on-site supervision/visitation.	0.4250	15

Frequency Adjusted Importance Index (FAII)

The Frequency Adjusted Importance Index (FAII) ranking

S/N	Potential Factors	FI	Ranking
06	Client's emphasis on quality.	42.188	01
11	Poor planning, scheduling, and monitoring.	36.719	02
03	Construction specific factors such as Codes and Standards, Drawings and Specifications, and Constructability of Design.	36.563	03
05	Client's emphasis on time.	35.984	04
08	Lack of communication among project stakeholders.	34.500	05
01	Human Resource Management.	34.453	06
02	Customer Satisfaction.	33.047	07
07	Effectiveness of construction team leader.	33.000	08
04	Project management actions of the project team (Managerial Control, level of administrative ability)	32.313	09
09	Unskilled and inexperienced trade subcontractors, sub-suppliers, and consultants.	31.250	10
15	Financial difficulties faced by the contractors.	28.750	11
13	Changes in the client's requirements.	28.125	12
12	Incomplete design drawings at tendering stage.	27.547	13

14	Fluctuation of material cost.	26.016	14
10	Poor on-site supervision/visitation.	22.844	15

Conclusion

The result of the study shows the impact level is different from one geographical area to another although most of the factors impacting the quality of the project during the construction phase are the same in different geographical areas.

The study shows that the Client's emphasis on quality and time, Poor planning, scheduling, and monitoring, Construction specific factors such as Codes and Standards, Drawings and Specifications, and Constructability of Design in addition to Unskilled and inexperienced trade subcontractors, sub-suppliers, and consultants are the highest factors that have an impact on the project quality inside Saudi Arabia during the construction phase of the project.

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العوامل المؤثرة على جودة مشاريع البناء في قطاع النفط و الغاز بالمملكة العربية السعودية

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