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Significant risk factors affecting construction projects in Yemen

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ABSTRACT

Yemen's construction industry faces many risks unknown to its players. This study aimed to identify the significant factors that affect construction projects in Yemen. A study used both qualitative and quantitative methods to enhance the study findings. Thus, 82 factors were extracted and categorized into 16 groups, which were the basis of questionnaire design. The study confirmed tool's reliability and validity after the removal of group 16 of the tool. The relative importance index (RII) analysed the data according to their importance. The study's findings determined 10 significant factors affecting the construction industry in Yemen, such the contractor's financial difficulties, currency exchange rate, and price changes (material & energy). This study recommends selecting contractors in light of their financial and technical capabilities, enacting laws granting professional grades to engineers, and activating the authorized training.

1. Introduction:

In recent, risk management becomes a key success factor for construction industry. Indicators of success in the construction industry include the completion of work within cost, time, and quality. These objectives already have interconnected leading to affecting and affected each other's (Abd El-Karim et al., 2017). Risk management is a systematic process for identifying, analysing, assessment and responding to risks throughout the project life cycle. As well, risk plays significant influences on construction industry that is well-known being suffering risks (Abd El-Karim et al., 2017). Therefore, project risk is an uncertain probability, if it occurs; it positively or negatively affects project objectives. It is concerned with minimizing the negative effects and increasing the positive effects of the project objectives (Faridi and El-Sayegh, 2006). Negative impact of risks on project objectives may cause cost overruns, behind schedule, quality problems, and safety issues (Abd El-Karim et al., 2017).

Many studies have discussed risk factors in several countries to investigate their effects on projects. El-Sayegh (2008) proved that the critical factors in UAE led to delays in the time of projects in construction industry. In Hong Kong, three risk factors were ranked as the top risk factors which had the most significant effect on the performance of projects (Shen, 1997). Also, in China, some factors related to client were identified as the most significant factors affecting their projects (Zou et al., 2007).

Delays is considered one of the effect of risks which was clearly in a study reporting that the project parties performance, environmental conditions, participation of other parties, contractual relationships, and availability of resources were the factors of risk which have led to delays of projects in construction industry in UAE (Faridi and El-Sayegh, 2006). As well, delay happens from other risk factors relating to schedule which finds its importance in projects influencing the margin of profit and the cost (Muneeswaran et al., 2018). Furthermore, many uncertain events related to many risks affect construction projects are but not limited to legal & regulations, natural, financial, technical, design, construction, and labour (Khan and Gul, 2017, Wu et al., 2017).

Like many developing countries, Yemen's construction industry faces many developmental constraints, such as inadequate techniques for implementing building, changes in prices, and inappropriate building materials. These restrictions have become difficult conditions in Yemen. In addition, inefficient execution of buildings and inappropriate technologies affect the efficiency of the construction process (Sultan and Alaghbari, 2014). The main pressure in Yemeni construction industry is the fast change from traditional building methods to modern. The surge in construction and rapid urbanization has led to a lack of skilled labour and materials of building. Shortages of materials, poor projects management (including risk management) and deficiencies of design and work were another obstacle. Absence of local laws and regulations has exacerbated problems and the emergence of many risks affecting the construction industry (Sultan and Kajewski, 2006, Bahamid et al., 2020). Obviously, construction projects face many challenges in terms of management, tools, fund, materials, and cost. The construction industry in Yemen is a highly dependent on imported materials due to the increasing demand for construction and new technology (Sultan and Alaghbari, 2014, Bahamid et al., 2020). In addition, Yemen's construction industry suffers from a shortage of professional staff at all levels of management and fieldwork among all construction parties (Sultan and Kajewski, 2003, Bahamid et al., 2020). Otherwise, the present construction industry in Yemen has a challenge that appears in delays, quality, and cost overruns (Sultan and Alaghbari, 2014). Alaghbari et al. (2017) mentioned that international reports from (BBC 2016; IRIS 2017; Sharp 2017) summarised the crisis of Yemen as follow:

Yemen suffered from the crisis of the Arab Spring since 2011, which was in time of political turmoil that led to civil war affecting sectors of national economy and GDP and thus Yemen has divided in two governments in Sana'a and Aden. The war has had negative effects on all sectors, including health, economy, education, society and others. The biggest impact was on the economy sector, including the construction industry, in terms of cost, time, and quality due to the closure of ports, airports, seaports, and blockade. Consequently, costs have increased, as have risks that negatively impact the construction sector.

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Yemen is a developing country with growth in the construction industry which faces many difficulties and challenges in terms of the three objectives of any project (cost, time, and quality), in addition, civil wars and political crisis. Moreover, the construction industry in Yemen lacks to identify the risk compared with other industries. Consequently, many construction projects suffer from risks that have not been identified yet. Therefore, the risk factors affecting projects have to be investigated in deepness. The purpose of the study is to identify the risk factors affecting construction projects in Yemen. The study's findings can help the players of the Yemeni construction industry to develop a full awareness of the critical risk factors that affect their projects' performance as well as to help project managers to avoid those factors and mitigate their impact.

1.1. Literature Review

The construction industry is exposed to many risks (Zavadskas et al., 2010), which are problems that have not yet occurred but may cause some loss or threat to the project's success (Kerzner, 2017). Also, risk is an event to be known as a probability, while uncertainty is a position in terms of numerical probability, which is characterized by a lack of awareness about the outcome of the event, which cannot be determined (Perminova et al., 2008). In other words, Risks can be interpreted as events that may affect the project objectives positively or negatively and occur in small and large environments. Furthermore, risk management can be defined as a system that aims to define and assess risks for businesses and projects. Therefore, the appropriate decision must be made on how to manage risk (Markmann et al., 2013).

Several steps follow risk management as follow:

1. Identify risks (Li et al., 2013, Hanna et al., 2013).
2. Assess risk (Ke et al., 2012, Markmann et al., 2013) and
3. Monitoring and responding the risks (Zhao et al., 2014).

These steps aim at reducing losses and increasing opportunities. Comprehensive literature reviews explain the importance of risk management (Hanna et al., 2013). Also, risk management are used to achieve the three project objectives (Subramanyan et al., 2012, El-Sayegh and Mansour, 2015, Liu et al., 2016), therefore, the entity responsible for risk event is called the 'Risk Owner'(Yoon et al., 2014).

Construction projects provide a suitable environment for the risks study and factors because they face many risks that affect the three objectives of the project. Risk factors are therefore determined in the light of risk assessment or models or tools developed through available information (Muneeswaran et al., 2018). However, many studies examined risk factors and identified their importance and classified them. More specifically, the risk involves profit and loss of the organization, and in this regard, risk identification would be to share the success of the project. Risk factors are detected during project implementation where organizations can prevent investment damage (Imran et al., 2019), and can be identified through many of indicators that verify, monitor, and analyse the risk categories (Al Nahyan et al., 2018). Therefore, Construction processes show different categories of risks. As well as, there are many stakeholders in the construction projects, which makes the assessment process as a difficult network (Muneeswaran et al., 2018), among all factors, achieving the objectives of the schedule is the most noticeable. Therefore, it is considered as a desirable result from all parties of the project upon its success (Aziz, 2013). In Indonesia, a study of 31 projects was discussed from the point of view of finishing projects on time limit, where the study determined that about 15% of project managers finished their projects by 70 to 90%, about 54% of managers completed more than 90% of their projects, and about 30% of managers completed their projects by less than 70%. (Kaming et al., 1997).

Delays are considered the most effect of risk that can be happened for any projects. In a study to determine the causes of delay in the large construction projects in Saudi Arabia, Muneeswaran et al. (2018) mentioned that Assaf et al. (1995) explored 56 risk factors in Saudi Arabia, and identified the critical factors affecting construction projects, which were 6 factors, namely Approval of operational drawings, delayed payments, design changes, inconsistencies among subcontractors, slow decision-making, and lack of labour, especially skilled labour. In addition, Assaf and Al-Hejji (2006) examined 73 causes for delays in Saudi construction projects. The most projects face delay in schedule of 10-30% of the original duration, indicating that delays are a serious problem in construction projects. As well, a study was conducted to identify delays and risk; this study identified 35 factors affecting projects in India. A method of this study was a questionnaire that extracted its factors from extensive literature review. The Relative importance index (RII) that was the technique of this study to analyse data is the common technique used in such researches (Muneeswaran et al., 2018). Furthermore, Iyer and Jha (2006) stated 55 factors influencing project schedule. Seven factors of them have a significant impact on schedule results.

Participants of construction projects have different perception of risks from each other in which is clear in many studies. Al Nahyan et al. (2019) studied 12 risk factors from stakeholders perceptions and their effect on construction industry in UAE. The stakeholders in this study were consultants, clients, and contractors. So, findings had been compared between clients, contractors, and consultants' perspectives. The factors of risk were grouped into three categories namely technical, financial, and decision-making. The findings reported that the consultants and clients demonstrate a superior comprehension of the different factors of technical hazard than contractors. From another side, contractors have demonstrated a superior comprehension of the various factors of decision from clients and consultants. This investigation likewise shows that the financial, technical, and decision-making are among the factors that can impact delivery procedures for large projects. Another study was conducted on perception of contractors on risk factors which affecting the construction projects in Jakarta. Significant differences were in the assessment of contractors on these factors due to the level of experience. Experienced contractors give high ratings for political, regulatory and environmental risks. Importantly, risks have classified into 8 groups namely contractual, technical, physical, personal, safety, design, political and regulatory, financial, and environmental and regulation causes risks (Santoso et al., 2003).

Many studies discussed the factors affecting construction companies from project point of view. Park et al. (2019) investigated the factors that affect execution of projects in Korea. Eight factors were identified and categorized into 6 groups namely contract, fund, schedule, workforce, customer satisfaction, and dispute. This study demonstrated that the delayed payment and the delay of project are the two significant risk factors influencing construction companies. Rezakhani (2012) provided that the company must control the risk of labour to benefit from professional and skilled labour as well as maintain the safety of employees as well as these steps can help in the success of projects.

Studies covered new approaches of projects such as fast-tracking and modular integrated construction projects to study their risks. A fast-tracking project study demonstrated by Rasul et al. (2019), this study classified risk factors into six groups' namely financial, legal, technical, managerial, environment, and social. Therefore, productivity, cost overrun, rework, time overrun, resource allocation, and quality of work consider the most significant factors affecting fast-track projects. As well, Wuni et al. (2019) studied the factors affecting modular integrated construction projects from several countries. This study identified 35 factors, top 10 of them are considered significant factors affecting projects that belong to the method of modular integrated construction. In the same line, a study on metro rail construction projects to recognize the significant risks from 8 factors. The study ranked the 8 factors according to their significance on the projects. "Raw material/quality control lab/casting yard/batching plant", and "concrete activities" are the two top critical factors (Sarkar and Singh, 2018).

A novel study concerning about sustainable construction projects in UAE was stated to examine the most significant risk factors influencing projects. The study identified 30 risk factors from the extensive literature review. Furthermore, the risks were classified into five groups namely management, technical, green team, green materials and regulatory/economic (El-Sayegh et al., 2018).

Financial risks are related to the company's capital, investment and corporate loans (Sapienza et al., 2009). Xenidis and Angelides (2005) reported that currency exchange, capital cost and inflation were the

main financial risks that exceeded the cost of the project. In another study, heavy loans of the company reduce the profitability of the company (Aladağ and Işik, 2017). In addition, cost overruns were the reason of financial loss, because of this loss, customers and contractors could suffer greatly (Patah and de Carvalho, 2007). As well, Adafin et al. (2019) debated the factors in pre-construction stage that affect the budget. Thirty six factors were identified and categorized into seven groups namely client, planning and design, cost, market, project, bedding requirements, and external factors. An investigation demonstrated that the most critical factors are "client's change / changes in owner's requirements, quality of information and flow requirements, and availability of design information".

Technical risks are described as errors in estimation and incorrect calculations (Weick, 1997). The technical problem, complex design, insufficient expertise in new technology and the use of new technologies are the main reasons for the technical deception of any construction project (Gann and Salter, 2000), as well as, an external information delay, inaccuracy, frequent design changes, inaccurate design, and incomplete specifications have a major negative impact on design and the project success (Muneeswaran et al., 2018, Al-Ageeli and Alzobaee, 2016). According /to Perrow (2011) the most contractors face technology risks due to uncertainty with little experience in installing advanced technologies. In addition, it is not assured that the new technology use can raise the projects efficiency. However, the experimental investigation of technology risks is the most significant to judge the project success. Labour risks are related to poor management capacity, poor work efficiency, inability of professionals and managers, lack of staff insurance and inability to employ skilled workers (Wu et al., 2017). In addition, Ogwueleka and Udoudoh (2018) conducted a study about the risk effect on designs of construction industry of Nigerian. Twenty nine factors which extracted from the literature review investigated, as well as classified into four groups namely technical, project design, firm management, and external factors. This research's findings uncover the most significant risk factors: financial stability, contract conditions, environmental factors and bank interest rate.

Internal risk factors and external risk factors were classified by Low et al. (2019) as well as each classification had 21 factors. Internal factors are also classified into several categories: resources, project and client, technical, and legal. Moreover, external factors classified into several categories: economic; environment; soil conditions; and politics. This study demonstrates that the critical factors of both internal and external factors have a significant impact on infrastructure projects in Malaysia. In addition, external risks are explained as risks to the government such as bureaucratic regulations and excessive government actions due to other external risks, such as inflation in building materials and equipment. These types of risks cannot be handled by the project manager; however, companies can evaluate external risks to make better decisions about project success (Rezakhani, 2012). Moreover, external risks are categorized into political and socio-cultural risks (Jarkas and Haupt, 2015). Even though, some researchers identified external hazards as environmental factors such as risk, soil speed, humidity, noise and temperature (Imran et al., 2019).

There are other many factors affect the construction project success positively or negatively. Chandra (2015) identified six risk factors related to the success of the construction projects such as natural, design, resource, financial, legal and regulatory, and construction. Moreover, Imran et al. (2019) and Khan and Gul (2017) have discussed the factors influencing the construction projects. These risk factors which classified into five groups: design, financial, technical, labour, and external risks have positive influences on the project success. According to Almasi et al. (2011) changes in design are the construction project main risk. In addition, the design team's experience can also influence project success (Buvik and Rolfsen, 2015). Several studies such as (Subramanyan et al., 2012, El-Sayegh and Mansour, 2015, Liu et al., 2016) have demonstrated that the risk of wrong plans is firmly connected to the risk of lack responsibility of designers and experience. Change orders can also affect the original design and contract that would increase the original cost and schedule (Paksoy et al., 2019). Another study identified 105 risk factors affecting construction projects. This study proved that 16 critical factors increase the risk ratio negatively on construction projects and classified into groups according to the follows managerial, design, financial, technical (Silungwe and Khatleli, 2018).

It can be seen in the literature review, some risk factors have been repeated in other categories according to researchers' classifications in which this gives insight about the different perspectives in the field of risk management. Therefore, this study would classify the factors according to the most used in this field.

2. Research methodology

The methodology of this study was both qualitative and quantitative approaches. Where the study strategies were to use the literature review as a qualitative approach to enrich the subject with rich information, as well as the use of quantitative approach by collecting data through questionnaire and quantify the data to enrich the topic with accurate and clear information. This study used the two approaches to strengthen the search findings **fig**. 1 (Naoum, 2007). The study extracted the most critical risk factors from many studies of the literature review according to their findings which were 82 risk factors affecting the construction projects in order to investigate them Table 1. The author tried to classify the factors in conformity with all the classifications of other researchers and adopted the differences according to the author's point of view. These factors were categorized into 16 groups, which are Tender, Labour, Design, Contractor, Equipment, Materials, Client, Consultants, Technical, Financial, Decision-making, Legal, Economic, Supply chain, Project team, and Environment.

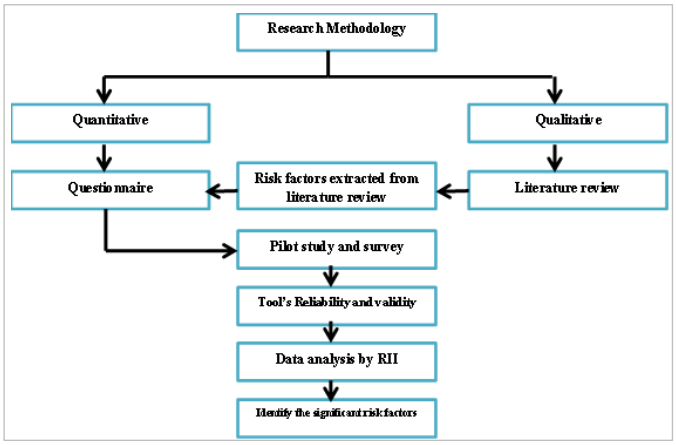

Figure 1: Research methodology flow chart. Source: Author, 2020

Table 1 Risk Factors of Construction Projects. Source: Author, 2020

classification	code	Factors	(MUNEESWARAN,2018)	(TEMBO SILUNGWE,2018)	(AL NAHYAN, 2019)	(LOW, 2019)	(WUNI, 2019)	(SARKAR, 2018)	(IMRAN, 2019)	(SANTOSO, 2003)	(PARK, 2019)	(RASUL, 2019)	(EL-SAYEGH, 2018)	(ADAFIN, 2019)	(OGWUELEKA, 2018)
Tender	X1	Inadequate tender documentation												α	
Labour	X2	Inadequate experienced labour	α												
	X3	Low productivity of labour	α												
	X4	Poor management ability							α						
	X5	Poor competency of labour							α						
	X6	lack of safety insurance of employee							α						
	X7	Lack of available workers									α				α

classification	code	Factors	(MUNEESWARAN,2018)	(TEMBO SILUNGWE,2019)	(AL NAHYAN, 2019)	(LOW, 2019)	(WUNI, 2019)	(SARKAR, 2018)	(IMRAN, 2019)	(SANTOSO, 2003)	(PARK, 2019)	(RASUL, 2019)	(EL-SAYEGH, 2018)	(ADAFIN, 2019)	(OGWUELEKA, 2018)
	X8	Inability of skilled labour							α						
Design	X9	Lack of design engineers experience	α						α						
	X10	Clarity of drawings and technical specifications		α											
	X11	Inadequate level of design quality and documentation			α										
	X12	Incomplete drawings			α				α						
	X13	Inaccurate design							α						α
	X14	Innovation of design							α						
	X15	, frequent changes in design							α				α		α
	X16	Incomplete specifications			α				α						
	X17	Errors and omissions in design drawings		α						α					
	X18	Availability of design information											α	α	
Contractor	X19	Contractor's underestimate of construction cost		α											
	X20	Contractor's financial difficulties		α											
	X21	Defective workmanship and rework		α								α			
	X22	Problem in co-ordination of subcontractors								α					
	X23	Communication and co-ordination problem with consultant								α					
	X24	Contractor’s productivity problems										α			
	X25	Poor supervision on site		α											
Equipment	X26	Low efficiency of equipment	α												
	X27	Selection of Methods and equipment										α			
Materials	X28	Poor quality materials		α											
	X29	Delay/lack of material supply				α									α
	X30	Quality of material below standards						α		α					
Client	X31	Delay in payment process by the client		α						α	α				
	X32	Client dissatisfaction with field service									α				
	X33	Client dissatisfaction with headquarters’ technical assistance									α				
	X34	Changes in owner’s requirements												α	
	X35	Client's financial instability		α		α							α		
Consultants	X36	Poor supervision		α											
	X37	Poor shop drawings approved by consultant								α					
	X38	Inexperience of consultants												α	
Technical	X39	Ineffective technical feasibility			α										
	X40	Project scope change/scope ambiguity				α							α		
	X41	Change in construction methodology at later stage due to constraints	α												
	X42	Deficient/inefficient WBS			α										
	X43	Complexity of project				α								α	
	X44	Tight schedule of project				α							α		
	X45	Insufficient experience of new technology and utilizing new technologies,							α						
	X46	Delay damages’ appearance										α			
	X47	Ineffective project planning and scheduling	α				α	α							
	X48	Site investigation incompetent												α	
	X49	Lack of talented people for handling jobs at site	α												
	X50	Quality expected beyond standard and specs								α		α			
	X51	Iinefficient Inspection activity						α							
	X52	Project delay													
	X53	Inefficient Maintenance activity						α							
Financial	X54	Improper budget allocation			α	α									
	X55	Ineffective the financial feasibility			α										
	X56	Currency exchange rate							α						
	X57	Cost of capital					α		α		α				
	X58	Cost overrun							α						
	X59	Market condition												α	
	X60	Bank interest rate													α
Decision-making	X61	Improper delegation of decision-making authority			α										
	X62	Ineffective decision-making structure			α										
	X63	Slow decision making			α										
	X64	Inefficient documentation activity						α							
Legal	X65	Insolvency of contractor/sub-contractor				α									
	X66	Contractual disputes and claims				α									
	X67	Contract revocation									α				
	X68	Poor government support and regulations					α								

classification	code	Factors	(MUNEESWARAN,2018)	(TEMBO SILUNGWE,2018)	(AL NAHYAN, 2019)	(LOW, 2019)	(WUNI, 2019)	(SARKAR, 2018)	(IMRAN, 2019)	(SANTOSO, 2003)	(PARK, 2019)	(RASUL, 2019)	(EL-SAYEGH, 2018)	(ADAFIN, 2019)	(OGWUELEKA, 2018)
	X69	Legal dispute with a client									α				
	X70	Contract condition													α
Economic	X71	Price changes (material & energy)				α									
	X72	Economic recession				α									
	X73	Inflation rate				α			α	α					
Supply chain	X74	Poor procurement system	α												
	X75	Incompetence of supplier													α
	X76	Late in material delivery					α			α					
	X77	Inability of professional and managerial							α						
Project team	X78	Inexperienced project manager				α									
Environment	X79	Hazards of site							α						
	X80	Humidity							α						
	X81	Noise							α						
	X82	high temperature							α						

2.1. Sample Size

The architects and civil engineers who were contractors, consultants or both were the targeted population in construction industry in Yemen. According to Alaghbari et al. (2017) the sample can be calculated due to the following equation:

$$n = \frac{m}{1+(\frac{m-1}{N})} \quad (1)$$

Where n is the sample size, and m is an available population which can be calculated according to the equation (2):

$$m = \frac{z^2 * p * (1-p)}{e^2} \quad (2)$$

Where **z** is the statistic value for the confidence level used (in this study 95% confidence level) thus z value was 1.96, and **p** is the value of the population proportion that is being estimated, in this study, the p value was unknown so it was suggested of 0.50 which is high for such research. **e** is the sampling error which was 0.05.

$$m = \frac{1.96^2 * 0.5 * (1-0.5)}{0.05^2} = \approx 384$$

Because the numbers of engineers were not known; the number of firms can be used to calculate the sample size. Therefore, the ministry of public works and highways registered 206 construction firms. Then the sample size is:

$$n = \frac{384}{1+\left(\frac{384-1}{206}\right)} = 135$$

2.2. Survey

Based on the factors that identified through literature were used to construct the questionnaire which consisted of 16 scales (groups). The questionnaire version was in Arabic language which is the formal language in Yemen. This study designed the questionnaire according to likert's five scales approach (1-5), which was used to scale responses in survey research ranging from "very disagree" to "high agree". The pilot study was done to check the words and meanings of the questionnaire; five experts checked the questionnaire. Then, their feedbacks were returned and the modified was done. In order to be 100% confidence, the author also conducted a pre-test on small group of academics. So, the feedback helped the author to develop the questionnaire so that the questionnaire was ready for distribution on large scale. Questionnaires were sent by e-mails and social media (WhatsApp, Facebook, etc.) as well as delivered hardcopy to the respondents; the returned questionnaires were 200, which referred to the high response for such researches. The respondents' characteristics showed highly qualifications of experience. This would support the generalization of this study.

2.3. Respondents Profile

The results of the field survey showed that the majority of respondents were consultants by 81.8% and the rest of 18.2% practiced as contractors and consultants. The survey also showed that 27.3 per cent had less than five years of experience, 31.8 per cent had experience of five years and less than ten years, and 40.9 per cent had more than 10 years of experience. Respondents had high experience indicating that they could answer questionnaire questions more accurately based on their experience in the field. Therefore, this author gave great confidence in the survey results.

2.4. Reliability

This study is exploratory research, thus the Cronbach's alpha can't be below the 0.60 (Hair et al., 2019), in this study's instrument, there were 16 scales in order to identify the risk factors affecting the projects in Yemen. The SPSS 19 IBM was used to calculate the reliability for the items (questions) of each scale. The scale 1 and 15 had one item which indicated that the item was reliable. As well, the scale 16 had value of 0.40 which was less than 0.60 indicating that this scale was not reliable and should be eliminated. The scales' reliability coefficients of other were from 0.66 to 0.87 which indicates that the instrument of this study was reliable Table 2. Consequently, the groups of this study became 15 scales (groups).

Table 2 Reliability Test's Results. Source: Author, 2020

Scale	No. of items	Cronbach's alpha
1	1	reliable
2	7	0.78
3	10	0.87
4	7	0.81
5	2	0.66
6	3	0.70
7	5	0.85
8	3	0.82
9	15	0.82
10	7	0.84
11	4	0.79
12	6	0.70
13	3	0.84
14	4	0.84
15	1	reliable
16	4	0.40

2.5. Construct Validity

Of Prime importance, to check the validity of this study's instrument, the exploratory factor analysis was used for data reduction, because this study was exploratory. Before conducting the exploratory factor, the correlation should be checked between the items (questions) and its scale (group). The correlation should be higher than 0.30; those which are lower than 0.30 do not share enough variance with the other items in that scale and should be eliminated after checking its content validity is there a rational to be used (Ferketich, 1991). It can be seen, the scale 1 and scale 15 had only one of question which indicated these items had appropriately assigned to their scales. In Table A.1 of Appendix A, those which are lower than 0.30 were checked their contents validity which indicated that their contents were important to the study. All other items that had value greater than 0.30, were appropriately assigned to their scales.

In this study, the sample size was 200, so the factor loading should be 0.40, which was used ass the usual cut-off point, as well as the Eigen-value should be greater than or equal to one. Correspondingly, if any item is loaded on two factors, then the content validity should be checked in order to eliminate it or not (Hair et al, 2014). Therefore, SPSS IBM 19 performed the exploratory factor analysis to test each

scale separately. In Table A.2 of Appendix A, the results of exploratory factor analysis for 15 scales were listed according to No. of factors, Eigen-value, and percentage of variance. Scale 1 and 15 had only one of question which indicated that scales were valid. Scales 5, 6, 8, 11, 12, 13, and 14 had loaded Only on one factor and had Eigen-value greater than one, thus there was no needs for using varimax rotate to be check, and these scales were valid. Furthermore, other scales 2, 3,4, 7, 9, and 10 had loaded on more than one factor, and some of their items (questions) had value equal to or greater than 0.40 which indicating that these items should be checked for their contents validity or should be eliminated see Table A.3 of Appendix A for rotated factor. After the content validity was checked, all items showed their importance for this study. So, there was no reduction of data which indicates that the instrument was valid. Furthermore, after the instrument became reliable and valid, the data should be analysed in order to determine their weight.

This study used RII to analysis the data from the questionnaire. This technique is a common technique for such researches (Silungwe and Khatleli, 2018, Muneeswaran et al., 2018). Therefore, RII can be calculated according to the follows:

RII = Sum of weights (W1 + W2 + W3 + ……+ Wn) / A x N

Where W = weights given to each factor by the respondents and will ranges from 1 to 5

A = highest weight (i.e. 5 in this case), and N = total number of respondents.

In the next section, the data would be analysed and ranked according to their significant impact on the construction projects.

3. Results and Discussion

After the instrument of this study was reliable and valid, the analysis had been done by SPSS IBM 19 and MS Excel 2010. RII was the technique which analysed the data of gathered questionnaires. Many studies consider the most significant factors that have value equal to or larger than 0.80 for RII such (Chan and Kumaraswamy, 1997, Muneeswaran et al., 2018). This study identified 16 groups and eliminated the sixteenth group according to its reliability. Fifteen groups were ranked in terms of their effect on the construction projects in Yemen Fig. 2.

It can be seen; group related to “Economic” had the first rank and value of 80.57% which considered the most significant group affecting the construction projects in Yemen. Also this group had two factors in the top 10 most significant factors affecting construction projects in Yemen.

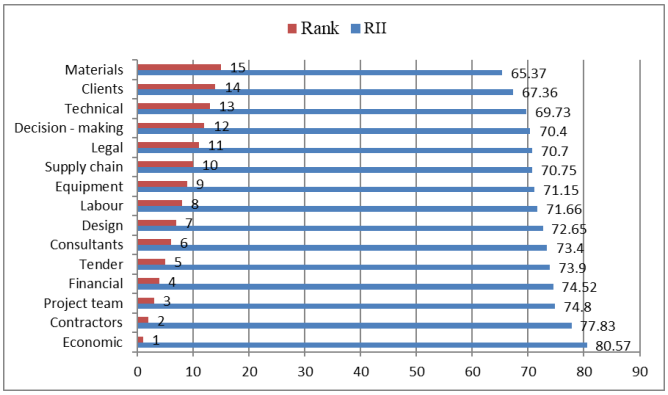

Figure 2: Risk Groups. Source: Author, 2020

With a RII of 77.83%, “Contractors” was ranked the second among the groups and had four factors in the top 10 most significant factors. Thus, it was considered the first group that had many factors of the top 10 most significant factors. The third place among groups was “Project team” with value of 74.80%, and did not get any factor in the top 10 most significant factors. The fourth was “Financial” which had only two factors of the top 10 most significant factors. With a RII of 73.90%, “Tender” was ranked the fifth among the groups, and also did not get any factor in the top 10 most significant factors. “Consultants” has the sixth rank with value of 73.40% and no any factor in the top 10 most significant factors too.

With a RII of 72.65%, “Design” was considered the seventh rank with only one factor among the top 10 most significant factors. Labour, Equipment, Supply chain, Legal, Decision-making, Clients, and Materials had been ranked eighth, ninth, tenth, eleventh, twelfth, fourteenth, and fifteenth, and had values of 71.66%, 71.15%, 70.75%, 70.70%, 70.40%,67.36%, and 65.37% respectively. They did not possess any factor of the top 10 most significant factors. The rank of the thirteenth was the share of the "Technical" which had the tenth factor of the top 10 most significant factors.

3.1. The Top Ten Most Significant Factors Affecting Construction Projects in Yemen

In Table 4, all factors are summarized by RII and listed in descending order according to their impact on construction projects in Yemen. The top ten factors have become clear and will be discussed in specific in the following **Fig. 3**.

Table 3 RII of Risk Factors. Source: Author, 2020

Code	Risk factors	Group	RII	Rank
x20	Contractor's financial difficulties	contractor	86.4	1
x56	currency exchange rate	Financial	84.3	2
x71	Price changes (material & energy)	Economic	84.3	3
x25	Poor supervision on site	contractor	83.5	4
x59	Market condition	Financial	82.8	5
x19	Contractor's underestimate of construction cost	contractor	81.8	6
x72	Economic recession	Economic	81	7
x9	Lack of design engineers experience	Design	80.8	8
x21	Defective workmanship and rework	contractor	80.7	9
x53	inefficient Maintenance activity	Technical	80	10
x58	cost overrun	Financial	79.2	11
x10	Clarity of drawings and technical specifications	Design	79.1	12
x66	contractual disputes and claims	Legal	78.1	13
x5	poor competency of labour	Labour	78	14
x52	Project delay	Technical	78	15
x6	lack of safety insurance of employee	Labour	77.1	16
x2	Inadequate experienced labour	Labour	76.6	17
x54	Improper budget allocation	Financial	76.5	18
x35	Client's financial instability	client	76.5	19
x73	inflation rate	Economic	76.4	20
x16	incomplete specifications	Design	76.2	21
x50	Quality expected beyond standard and specs	Technical	75.6	22
x11	inadequate level of design quality and documentation	Design	75.5	23
x4	poor management ability	Labour	75.4	24
x18	Availability of design information	Design	75.2	25
x78	Inexperienced project manager	Project team	74.8	26
x36	Poor supervision	Consultants	74.7	27

Code	Risk factors	Group	RII	Rank
x64	inefficient Documentation activity	Decision-making	74.6	28
x65	Insolvency of contractor/sub-contractor	Legal	74.5	29
x1	Inadequate tender documentation	tender	73.9	30
x37	Poor shop drawings approved by consultant	Consultants	73.8	31
x13	inaccurate design	Design	73.8	32
x12	incomplete drawings	Design	73.7	33
x26	Low efficiency of equipment	Equipment	73.5	34
x22	Problem in co-ordination of subcontractors	contractor	73.5	35
x57	cost of capital	Financial	73.4	36
x77	inability of professional and managerial	Supply chain	73	37
x48	Site investigation incompetent	Technical	72.6	38
x17	Errors and omissions in design drawings	Design	72.5	39
x34	Changes in owner's requirements	client	72.4	40
x63	Slow decision making	Decision-making	71.9	41
x8	inability of skilled labour	Labour	71.8	42
x76	Late in material delivery	Supply chain	71.8	43
x38	inexperience of consultants	Consultants	71.7	44
x51	inefficient Inspection activity	Technical	71	45
x68	Poor government support and regulations	Legal	70.8	46
x24	Contractor's productivity problems	contractor	70.8	47
x45	insufficient experience of new technology and utilizing new technologies,	Technical	70.7	48
x39	Ineffective technical feasibility	Technical	70.6	49
x75	Incompetence of supplier	Supply chain	70	50
x49	Lack of talented people for handling jobs at site	Technical	69.4	51
x30	Quality of material below standards	Materials	69	52
x28	Poor quality materials	Materials	68.9	53
x41	Change in construction methodology at later stage due to constraints	Technical	68.9	54
x70	Contract condition	Legal	68.8	55
x27	Selection of Methods and equipment	Equipment	68.8	56
x31	Delay in payment process by the client	client	68.4	57
x74	Poor procurement system	Supply chain	68.2	58
x55	Ineffective the financial feasibility	Financial	68.1	59
x69	Legal dispute with a client	Legal	68.1	60
x23	Communication and co-ordination problem with consultant	contractor	68.1	61
x40	Project scope change/scope ambiguity	Technical	68	62
x62	Ineffective decision-making structure	Decision-making	68	63
x46	Delay damages' appearance	Technical	67.1	64
x15	, frequent changes in design	Design	67.1	65
x60	Bank interest rate	Financial	67.1	66
x61	Improper delegation of decision-making authority	Decision-making	67.1	67
x3	Low productivity of labour	Labour	67.1	68
x47	Ineffective project planning and scheduling	Technical	66.2	69
x44	Tight schedule of project	Technical	64.3	70
x67	Contract revocation	Legal	63.9	71
x42	Deficient/inefficient WBS	Technical	62.8	72
x43	Complexity of project	Technical	61	73
x33	client dissatisfaction with headquarters' technical assistance	client	60.2	74
x32	client dissatisfaction with field service	client	59.3	75
x29	Delay/lack of material supply	Materials	58.2	76
x7	Lack of available workers	Labour	55.6	77
x14	innovation of design	Design	52.6	78

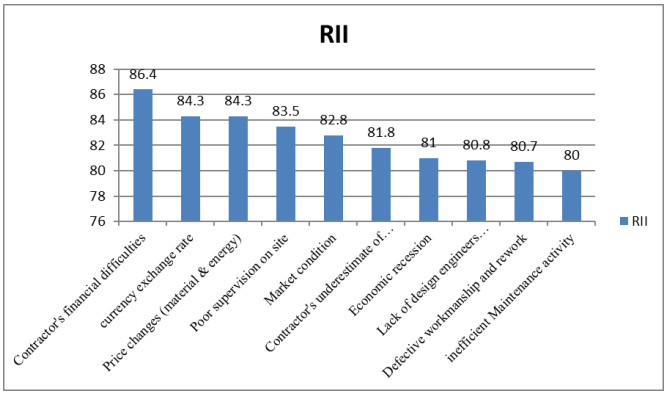

Figure 3: The most ten significant factors affecting Projects. Source: Author, 2020

In the first of the top ten most significant factors "Contractor's financial difficulties" has the first rank, and it belongs to the "Contractors" group which has also the first rank among the groups in the top ten significance factors. In Yemen as a developing country, most local contractors are not engineers but investors. Most of the projects submitted for tenders are by donor organizations through local organizations that do not focus on financial efficiency, which in turn, leading to bad result when projects implemented, the contractor cannot meet its contractual obligations due to financial difficulties. In this study, the "Contractor's financial difficulties" got a value of 86.4%, while in a study that was conducted in Zimbabwe by Silungwe and Khatleli (2018) it was 83%, and both results are close together. On the other hand, it was ranked fifth in Zimbabwe, due to the method of selecting contractors from the perspective of financial efficiency of contractors. However, this was one of the most significant factor affecting construction projects in both countries.

In the second rank, the "Currency exchange rate" which was under the group "Financial", is the significant factor that reflects the reality experienced by Yemen because of the on-going civil war, the economic blockade, the closure of land ports, sea ports, and airports except allowed, which does not meet the country's need of imports. All this has led to increase the price of Dollar. Consequently, construction projects are affected by the constant changes and increasing the foreign currency. This factor has become an obsession for all companies and organizations, which have led to the losses of contractors because of the high wages of labour and material prices directly with the change of currency exchange. It is clear that the currency exchange rate ranked second in Yemen, and the eighth by a study reported by Boateng et al. (2015). On the other hand it ranked 27th with RII value of 78% in Zimbabwe (Silungwe and Khatleli, 2018). This indicates that this factor negatively affects the financial issues of projects in case of change and instability. A study that was

stated by Imran et al. (2019) confirms that the financial factors (currency change, cost of capital, inflation rate) have significant effect on projects. As well, Santoso et al. (2003) concluded that the investors do not invest unless they are certain that the financial factors are secure. This supports the study finding.

In the third rank, the factor of "Price changes (material & energy), RII=84.3%" belongs to the "Economic" group and will be discussed from the perspective of the economy. The result of this factor confirms the current economic situation in Yemen due to the civil war and the closure of ports. As a result of these factors, the prices of materials and energy are affected and negatively affect the tenders and the implementation of construction projects in Yemen. This factor was ranked in first rank by a study investigated its impact on projects from economic point of view (Low et al., 2019). This factor is critical for contractors when they want to apply for tender according to uncertainty and in the implementation stage. Taylan et al. (2014) also confirmed that materials and overheads determine the cost of the project. This supports the finding of this study that the changes in material prices negatively affect construction projects, as well as supported by (Muneeswaran et al., 2018, Boateng et al., 2015, Potts and Ankrah, 2014, Silungwe and Khatleli, 2018).

The "Poor supervision on site, RII=83.5%" ranked fourth among the most significant factors affecting construction projects in Yemen. This finding confirms what has been said previously that most contractors are investors and rarely hire professional engineers. Moreover, some Yemeni engineers suffer from professional inefficiency and inadequate experience that negatively affects their performance. Most University graduates are treated as consultants in many local organizations and there are no laws governing professional degrees which have been confirmed by (Sultan and Kajewski, 2006). Therefore, many projects suffer due to inefficient supervision of construction works. This finding is supported by Silungwe and Khatleli (2018) who proved that this factor has a major impact on the construction projects. As well, this finding got RII value of 87.8% and ranked the seventh top significant factors by Muneeswaran et al. (2018) who also confirms the importance of skilled people to supervise the site. Also, this finding is supported by study's finding of Adafin et al. (2019).

The "Market condition" ranked fifth among the most significant factors affecting construction projects in Yemen. This factor falls under the "Financial" group which ranked fourth among the groups. Since the situation of the country is unstable, this certainly has affected the market condition in terms of demand and prices and affects the budget of the project. The importance of this factor was ranked fourth among the critical factors in the studies conducted by (Adafin et al. (2019), Akintoye (2000)) and (Odusami and Onukwube (2008)). Furthermore, all stages of the project is also affected by market condition leading to budget overruns which was supported with findings by Allan et al. (2008), Akintoye (2000), and Aibinu and Pasco (2008).

The "Contractor's underestimate of construction cost, RII=81.8%" ranked sixth among the significant factors and falls under the "financial" group. This result confirms what has been discussed previously about the ineligibility of local contractors, where most of are the investors and do not hire professional engineers, which in turn will lead to underestimate the costs of construction and lead to the risk of loss. As well as, this factor got the seventh rank by a study that was conducted by Boateng et al. (2015). In contrast, this factor ranked third in a study reported by Silungwe and Khatleli (2018), and this confirms the importance of this factor on Yemeni construction projects and supports the finding of this study. As well, it is supported by finding of a study that was stated by (Akinci and Fischer, 1998).

Economically, the "Economic recession, RII=81%" ranked seventh among the critical factors affecting Yemen's construction projects. This result confirms the economic situation that Yemen has suffered after the Arab Spring and the civil war, which led to an economic recession that Yemen has not seen in decades. This finding is confirmed by a study, which proved that the economic recession ranked first among the significant factors affecting the infrastructure (Low et al., 2019). Furthermore, findings of studies (Legacy et al., 2012, Frick, 2008, Haynes, 2005) support also finding of this study. So, this considers a best index supporting this study.

The "Lack of design engineers experience, RII= 80.8%" ranked eighth under the design group. Where in Yemen there are no laws governing the design process and its types related to the grade of professional engineers in terms of submission of documents and approving them by the competent authority, but the process is conducted freely without any laws. In addition, graduate engineers are employed as consultant engineers without any consideration of the laws that determine who is a consultant. This in turn led to poor design process. This finding is supported by a finding of a study, which proved that this factor ranked the third among the significant factors affecting the projects in India. The difference between the two countries' rankings may be due to the current economic situation and the political situation of the two countries. Another study proved also that the design team experience has a positive effect on projects success (Imran et al., 2019), in which this finding supports the finding of this study. As well, Many studies proved that the error and defects in design have a strong link with designers' experience (Subramanyan et al., 2012, El-Sayegh and Mansour, 2015, Liu et al., 2016). In addition, Silungwe and Khatleli (2018) investigated the factors affecting buildings in Zimbabwe and this factor get the rank of tenth among the critical factors. This also another index supports the finding of this study. Furthermore, this factor ranked the second in a study was conducted by Rasul et al. (2019) . Many studies support this finding such (de la Garza et al., 2016, Ballesteros-Pérez, 2017, Khoueiry et al., 2013, Adafin et al., 2019, Wuni et al., 2019).

Under the group of "Contractors", the "Defective workmanship and rework, RII=80.7%" ranked ninth among the most significant factors affecting construction projects in Yemen. This also confirms what has been discussed about the incompetence of contractors and often does not employ professional engineers, although there are criteria for the classification of contractors in Yemen, but the failure to apply these standards made the contracting profession take an incorrect course in Yemen. Many projects suffer from defects of work and return which leads to financial losses and exceed the time of the project. This factor ranked first among the critical factors in a study conducted by Rasul et al. (2019) on projects implemented by fast-track method, may be the reason that this factor got the first place is the stability of the country from any disputes and focus only on the technical aspects of implementation. In another study conducted by Silungwe and Khatleli (2018) in Zimbabwe, this factor ranked the sixth, this confirms that developing countries converge in the factors affecting construction projects. In contrast, in India, this factor got the sixteenth rank by RII value of 84% according to the respondents perception (Muneeswaran et al., 2018), as well as, in Australia got first rank (Tower and Bacarini, 2008). But, all the differences between the ranks are not significant and all findings confirm the importance of this factor on construction projects, in which supports the finding of this study.

Finally, the "Inefficient Maintenance activity, RII= 80%" factor ranked tenth under the "Technical" group among the significant factors. If contractors are unprofessional and often do not hire professional engineers or may employ graduate engineers, maintenance will certainly be inefficient. This is seen in many projects of the many clients' complaints about maintenance work that does not continue efficiently but only to deliver the work. A study conducted by Sarkar and Singh (2018) supports the finding of this study where this factor ranked seventh among the most significant factors.

4. Conclusion and recommendation

Construction projects in Yemen suffer from many risks that are not known to all parties. It was important to know what factors had a negative impact on construction projects. The aim of this study is to identify the critical risk factors affecting construction projects. The study used both qualitative and quantitative approaches to enhance the findings of the study. Eighty-eight factors were drawn from the literature review and classified into 16 groups, according to which the questionnaire was designed and judged by five experts. A study conducted a pre-test to check and develop the questionnaire. Furthermore, the reliability and validity of the study's tool were checked and the sixteenth group were eliminated, so the tool became reliable and valid. The information is therefore ready for analysis. The study used RII for data analysis. After analysis, the study identified the top 10 most significant factors affecting Yemeni construction projects. The topped factors were the contractor's financial difficulties, currency exchange rate, and price changes (material &

energy). The current situation in Yemen from civil war and economic blockade has had a major impact to determine these factors and its negative impact on construction projects in Yemen. Among the top ten factors, there were four factors belonging to the group of "Contractors", two factors belonging to the "Financial" group and two to the "Economic" group. And factor for both "Design" group and "Technical" group. The mechanism of selecting contractors, the absence of laws regulating the professional grades of engineers and their classification, and the employment of graduate engineers as consultants had an impact on the occurrence of these significant factors, which adversely affected the Yemeni construction industry. Therefore, the study recommends the following:

1. Guiding donor and local organizations to select contractors in light of their financial and technical capabilities.
2. The use of foreign currency in the contracting work and the development of a percentage of risks used according to the contract.
3. Enacting laws granting professional grades to engineers by the competent authorities and benefiting from the experiences of developed countries.
4. Training programs should be activated through authorized centres to qualify the professional engineers in order to avoid the defectives in design, estimates, quality, and other related process.
5. Establishing a real list of critical risk factors which can help the projects managers to avoid and mitigate the effect of those risks.

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Appendix A

Table A.1. Item to Scale Correlation (Pearson Correlation)

Item(Question)	Scales												
	2	3	4	5	6	7	8	9	10	11	12	13	14
	0.80												
	0.81												
	0.70												
	0.88												
	0.21												
	0.52												
	0.64												
		0.47											
		0.82											
		0.70											
		0.78											
		0.82											
		0.41											
		0.56											
		0.73											
		0.81											
		0.63											
			0.75										
			0.29										
			0.80										
			0.68										
			0.66										
			0.79										
			0.70										
				0.87									
				0.86									
					0.87								
					0.73								
					0.77								
						0.85							
						0.83							
						0.80							
						0.55							
						0.92							
							0.92						
							0.92						
							0.73						
								0.78					
								0.64					
								0.34					
								0.47					
								0.24					
								0.10					
								0.41					
								0.30					
								0.87					
								0.80					
								0.37					
								0.48					
								0.63					
								0.84					
								0.76					
									0.48				
									0.76				
									0.80				
									0.74				
									0.81				
									0.75				
									0.64				
										0.74			
										0.80			
										0.59			
										0.40			
											0.48		
											0.58		
											0.22		
											0.59		
											0.24		
											0.12		
												0.35	
												0.07	
												0.04	
													0.80
													0.92
													0.86
													0.72

Table A.2. Factor Analysis Test's Results

Scales	Factor number	Eigen-value	% of variance
1	Only one question		
2	2	3.30	47.26
		1.33	19.00
3	3	4.93	44.88
		1.78	16.18
		1.27	11.56
4	2	3.45	49.31
		1.12	15.97
5	1	1.48	74.34
6	1	1.88	62.82
7	2	3.22	64.49
		1.02	20.45
8	1	2.24	74.92
9	5	5.42	36.19
		2.53	16.91
		2.01	13.39
		1.48	9.90
		1.02	6.84
10	2	3.60	51.51
		1.35	19.35
11	1	2.47	61.91
12	1	2.43	40.54
		1.60	26.81
13	1	2.31	77.10
14	1	2.73	68.30
15	Only one question		

Table A.3. Shows Rotated Factor for Risk Factors Identification

Items	Rotated factor (Varimax)								
	Component (factor loading)								scale
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
X8	0.52	0.40							2
X19	0.67	0.46							4
X35	0.72	0.58							7
X40	0.70				0.55				9
X42		**0.47**			0.57				
X44			0.61		0.58				
X45			0.67		0.49				
X47	0.67	0.47							
X51	0.42	0.80							
X58	0.55	0.63							10