AN INVESTIGATION THE CAUSES OF PROJECTS DELAY AND COST OVERRUN FOR CONSTRUCTION INDUSTRY IN OMAN AND THEIR IMPACT ON REALIZATION OF OMAN VISION 2040

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Abstract

Construction industry in Oman is expected to experience growth owing to the ambitious infrastructural development plans Oman Vision 2040 that were put in place to put Oman economy on a high growth projector path as envisioned by His Majesty Sultan Haitham Bin Tariq, Sultan of Oman. Oman is considering breaking the cycle of over-dependency on Oil and Gas by reducing its hydrocarbon-derived GDP by 50% by 2040 to a more diversified economic base. Despite the huge numbers of researches on the construction industry performance worldwide for the past two decades, projects delay and cost overrun still is the most popular problems without effective solutions. Thus, there is a need to study in depth about the factors that causes projects delay and cost overrun in Omani construction industry. This study explored the major factors influencing projects delay and cost overrun in Omani construction projects. A quantitative study with 130 respondents from different projects stakeholders and different sectors involved in the construction industry in Oman. The study also identified the mitigation measures for eradicating such incidences. Based on the findings, a specific recommendation was given based on the projects stakeholders involved and based on identified causes which can be used by projects management professionals to prevent the projects delay and cost overrun. The study identified that the projects delay and cost overrun would have significant impacts on Oman economic growth. The study gave practical recommendations which can be used by Oman government organisation and decision makers to accelerate the country economic growth and implement the Oman Vision 2040 effectively.

Keywords: Delay, Cost Overrun, Mitigations, Oman Vision 2040, Economic Diversifications

INTRODUCTION

Construction industry is one of the most important sectors for the development of any given country. Completion of a construction project without any claims is one of the indicators of success in the construction industry. However, construction projects in most cases are marked with overrunning time and costs Emam, Farrell & Abdelaal, (2014). Johnson and Babu (2018) feel that the global construction industries are suffering with poor time and cost performance. A number of studies have been carried out both nationally and internationally to establish the causes of delay and cost overrun of projects in the construction industry. The findings have indicated that causes of projects delay and cost overrun in the construction industry differ from one country to another and even between projects that are within the same geographical radius (Emam, Farrell & Abdelaal, 2014). Therefore, a case-by-case analysis of the causes of projects delay and cost overruns remains the most effective way of identifying project-specific causes.

As per the (Oxford Business Group, 2017) the contribution of the construction sector to Oman GDP in 2015 was ($5.4 billion) which accounted for 10.9% of the contribution of non-petroleum activities to the Omani GDP, which makes the construction sector the third most productive non-oil sector. Construction activities in Oman is expected to experience growth owing to the ambitious infrastructural development plans that were put in place to put the economy of the country on a high growth projector path as envisioned by His Majesty Sultan Haitham Bin Tariq. Sultan Haitham identified infrastructural development as one of the key building blocks for the achievement of the Oman infrastructural and economic development (HE Talal al Rahbi, 2020). Most of these construction projects include projects in hydrocarbon, energy, water, highways and hotels in major cities involving investments of billions of dollars (Oxford Business Group, 2017).

Construction project claims and related disputes occur in both publicly and privately funded projects, both small, medium and mega projects, involving both small and large amounts of money. Therefore, there is no project in the construction industry in any country is considered safe from claims of projects delay and cost overruns which have greatly significant financial implications to all stakeholders (Client, Consultant and Contractor) of the projects. Therefore, it is important for all Projects stakeholders and Projects Management professionals involved in the construction industry to put in place mechanisms of ensuring that the construction projects conceived and initiated remain on course in terms of budget and timelines in order to avoid the unfortunate incidences of projects delay and cost overruns (Enshassi, Choudhry and El-Ghandour, 2009).

Research Problem

Even with increased attention demonstrated by the growing number of publications on the topic of construction management and related performance fields for many decades, the construction industry continues to experience the same problems of cost overruns and delays (Gastelum, 2016). The academic researchers and practitioners have demonstrated their ability in creating successful hypotheses, run cycles of tests that lead to changes in industry practices and poor performance. However, it is important to note that delivery professional projects and services need an industry-driven and proven solution to help in overcoming the seemingly inevitable poor performance. The solution they propose to deal with the problem of overruns should be simple and straightforward to be implemented all over the world (Alfredo, Kedar and Alhammadi, 2017).

Identified Gap

The Oman vision 2040 plans have identified infrastructural development as the enabler through which the Sultanate can achieve its goal of having a diversified economy from overdependence on Oil and Gas to non-Oil sectors. However, all current studies have not been carried out to identify causes of delays and cost overruns in the construction industry in Oman in the context of the pivotal role of the construction sector on realization of the Vision 2040. Existing researches on the problems facing construction industry in Oman is based on achievement of goals of the individual construction projects. Decisions like the recent cutting of funding to the construction sector are based on other factors of the economy and not on the realization of the pillar of building excellent infrastructure and livable cities as envisioned in the Oman Vision 2040. Therefore, there is need to carry out research to determine problems in the construction industry that may hinder achievement of the Oman vision 2040 and propose mitigation measures to ensure achievement of this vision.

Objectives of the Study

Based on the above studies and the gaps identified in the construction delays and cost overruns, the main objectives of this study are:

1- To identify the factors that causes cost overrun and delays in Omani construction projects and to evaluate the relationship between latent variables (External factors, contractual issues, planning, design & documentation, execution-related factors, financing, material-related factors and labour and manpower) and the construction project cost and delays in Oman.

2- To identify the stakeholders responsible of the construction project delays and cost overruns.

3- To identify the factors that have highest impact on the construction project delays and cost overruns.

4- To identify the measures that could be used to mitigate the main factors causing increased project delays and cost overruns.

5- To identify the impact of the projects delay and cost overrun to the Oman economic growth and implementation of Vision 2040 blueprint strategic development plan.

Significance of the Study

Projects delay and cost overrun have become a major problem in the construction industry of the Sultanate of Oman and these have a negative impact on the economic development of the country. It is therefore important to have a clear understanding of the causes of these project delays and cost overrun in Oman so that appropriate measures can be instituted to mitigate these problems and ensure that projects in the Omani construction industry as per Oman Vision 2040 are completed on time and within the budgeted cost. This will in turn spur economic growth as economic activities rely on adequate infrastructure for them to flourish and grow the economy of the Sultanate of Oman. By investigating the causes of delays and cost overruns and their effect on the achievement of the Oman Vision 2040, the research will recommend the mitigation measures and return the contribution of the construction industry to the GDP on a growth trajectory. This study is different than the other researches because it covers all regions and cities in Oman and all construction industry sectors (electrical power supply and distribution, water dams and distribution network, hydrocarbons, Oil, Gas petrochemical, logistic (roads, highways, sea ports and airports) and infrastructures and buildings. I addition to that The study also identified the mitigation factors for eradicating such incidences which can be used by projects management professionals to prevent the projects delay and cost Overrun. The study identified that the projects delay and cost overrun would have significant impacts on Oman Economic growth. The study gave practical recommendations which can be used by Oman government organisation and decision makers to accelerate the country economic growth and implement the Oman Vision 2040 blueprint effectively.

LITERATURE REVIEW

In its quest to identify the causes of project delays and cost overruns in the construction industry, the literature review identified project management as the use of skills, tools and methods to accomplish the goals set for a given project. The review recognizes that though project management is carried out under rigorous planning, more often projects extend their completion dates and surpass the budgetary constraints set out at the initial stages of project

management. It has also been established the phenomenon is common in the construction industry.

In order to understand the sources of projects delay and cost overrun, the literature review highlighted the role of key stakeholders in the construction project management who include the client who is the project owner and sometimes the sponsor, the contractor who is contracted to build the project and the project consultant who is an expert that comes up with the design of the project and provides advise on technical aspects of the project.

The literature review then delves into the main objective of the study to identify the specific causes of projects delay and cost overruns in Omani construction industry. Various researches conducted with respect to Omani construction projects were studied and analyzed in this section.

Alzebdeh et al (2015) studied the cost overruns in the construction projects using interpretive structural modeling. Their study identified that instability of the US dollar and changes in governmental regulations are the major two external factors that influence the project cost overruns. Faulty cost estimation and poor coordination between the project parties are the two major internal factors that affect the project cost overruns.

Al Nasseri and Aulin (2016), investigated the factors that are enablers and barriers for the construction projects. These enablers and barriers are the factors that decide the success of the project. It is reasonable to argue that the quality of a project schedule is a key factor both in determining the duration of the project with sufficient accuracy and in managing the physical execution of the work. Enablers and barriers to reliable project planning and scheduling are therefore of interest.

Albalushi et al (2013) studied the causes and consequences of cost overruns and variations on public constructions in Oman. They identified that the changes in project scope, material qualities, design errors, improper cost control in design and construction stages shall be reasons for cost overruns which increases the project cost and utilize the funds allotted for other project or add more funds.

Al Saadi et al (2018) studied the perspectives of time overruns on construction projects in Oman. Their study showed the following factors are the causes for time delays in order: Mistakes during construction and Shortage of technical personnel (skilled labour), Insufficient data collection and survey before design and Inadequate details provided in drawings, Incomplete design at the time of tender, Change in the scope of the project, Lack of communication between parties, Inadequate monitoring and control.

Alnuaimi and Al Mohsin (2013) studied the causes of delay in construction project delay in Oman. They identified the factors and sub factors: Possible changes in initial design and

complexity of the project may be considered as design related delays. Variations and claims, change of scope of project shall be considered as construction related delays. Financial ability of the owner, insufficient funds shall be considered as factors related financial / economic related delays. Lack of suitable management team, unspecialized sub-contractors, lack of project management, lack of experience of the consultant and contractors are the administrative or management related delays. New legal instructions and rules is the regulations or code related delay.

Alamri et al (2017) studied the reasons for delays in dam's project construction in Oman. They conducted a survey with 60 factors that may cause delays and cost overruns in dam construction projects. Their study identified that following causes for delays and overruns: severe weather condition, change orders, uncertainty in ground condition, poor site management, executive bureaucracy in client organization, improper feasibility study, natural effects during construction work, difficulty of defining project Requirements, slowness of decision making process, delay of obtaining permit/approval from the different government authorities and land acquisition.

Al Battashi et al (2018) conducted a study on causes of construction wastes. Their study identified the following factors as top five causes for construction waste: Poor site management and poor supervision under management category, frequent design changes under design category, wrong material storage under handling category, and waste resulting from packaging under site condition.

In summary, they include poor cost estimation, unrealistic timelines and inadequate risk analysis and assessment at the project planning phase. Project delays and cost overruns are also caused by project design variations, frequent project change orders by client and inadequate project details at the project design phase. Project delays and cost overruns also occurring during implementation of project plans whereby issues like inadequate experience by the contractor in such projects, poor communication and coordination, unclear project designs and low performance of subcontractors for the tasks assigned to them at the project execution phase.

The literature review also highlights the strategies and measures that have been used to mitigate the problem of project delays and cost overrun in Omani construction industry identifying use of adequate and effective project plans and construction methods, embracing close-loop management system, embrace knowledge management, implement projects based on sustainable development goals and applying the lessons learnt from the feedback obtained.

Oman has greatly invested in infrastructural development with a multibillion public sector contracts, which together with other significant private sector construction projects that are projected contribute immensely to the growth of the construction sector that will in turn transform the Omani economy. In the wake of strong headwinds occasioned by a significant drop in oil prices from mid-2014, the Omani government has now focused on diversifying its economy by investing heavily in infrastructural development as per Oman Vision 2040 development plan.

RESEARCH METHODOLOGY

The research will use both primary and secondary data. Secondary data mainly consisting of causes of delays (waiting time) and cost overruns was obtained using a critical review of the existing body of literature on the causes of projects delay and cost overrun and mitigation measures instituted to address them. The study has also made use of reports from Oman construction industry and special government policy documents such as Oman long-term blueprint Vision 2040 to identify the industry's obligations towards meeting the overall growth and development plans of the country. The purposive sampling will be used to identify the population sample to be used to ensure that information is collected from knowledgeable people and therefore useful for the study and the Stratified random sampling will be used to select participants of the study from the targeted population.

The primary data was collected through developed questionnaire based on literature review and was distributed through an electronic online Survey Software (Qualtrics survey Solutions) that was sent by email to the professional project management practitioners such as Senior Project Directors and Managers, Senior Projects Engineers, Projects Engineers, Contractors Managers and Engineers, Project Control (Cost and Schedule) Managers, Cost Estimators and Projects Planners from all projects stakeholders (Clients, Consultants and Contractors) involved in all type of construction industry sectors in Oman.

To calculate the sample size as the population size is finite and the research uses Stratified Random Sampling Technique to select the sample, the following formula was used.

Sample Size for Infinite Population (Si) = $\dfrac{z^2 * p(1-p)}{c^2}$

Where,

z = critical value for the chosen confidence interval, p is the percentage of the population and c is the confidence level.

To correct the sample size and to calculate for the given finite population, the following formula was used.

Finite Sample Size (n) = $\dfrac{S_i}{1 + \dfrac{(S_i - 1)}{N}}$

Where,

N is the population size.

The following parameters were assumed for the sample size calculation. The critical value z at 95% confidence level Zc = 1.96 and the percentage of population is 50% which is the normal value. Hence, the questionnaire was distributed to maximum number of respondents so that minimum 130 samples shall be collected. The population sample used in the study was representative of all regions in Oman and the major sectors of the economy including Oil & Gas, Infrastructure, logistics i.e. Sea and Air ports, highway and roads, power generation, water projects and telecommunications. Due to The COVID – 19 pandemic made the data collection process significantly difficult from the targeted survey population. Furthermore, the questionnaire formed long, comprised of 109 questions and this made it significantly challenging participants to start, continue and complete the questionnaire. This led to reduced data used in the study. Out of the 207 responses received, only 130 cases were used as 77 cases were removed from the statistical analysis as they had a significant amount of systematically missing data.

The data collected through the questionnaires was analyzed using Partial Least Square Structural Equation Modelling (PLS-SEM) (Hair et al., 2013). The questionnaires identified causes of projects delay and cost overrun which consisting of 8 main factors, 29 sub factors and 76 questioned items. The ordinal scale will rank responses in terms of severity of the factors such that: 1= Very low, 2= Low, 3= Medium, 4 = High and 5= Very high and the impact of each independent variable on a dependent variable (Henseler et al., 2016) was identified and analyzed. The questions were classified into eight categories (independent factors) as follows: (Project planning related causes, design and documentation related causes, construction material-related causes, contractual-related causes, project execution-related causes, manpower -related cause, financial or economic causes and external factors (moderating variable) on project delays (time) and cost overruns (Dependent factors). As per the conceptual research framework
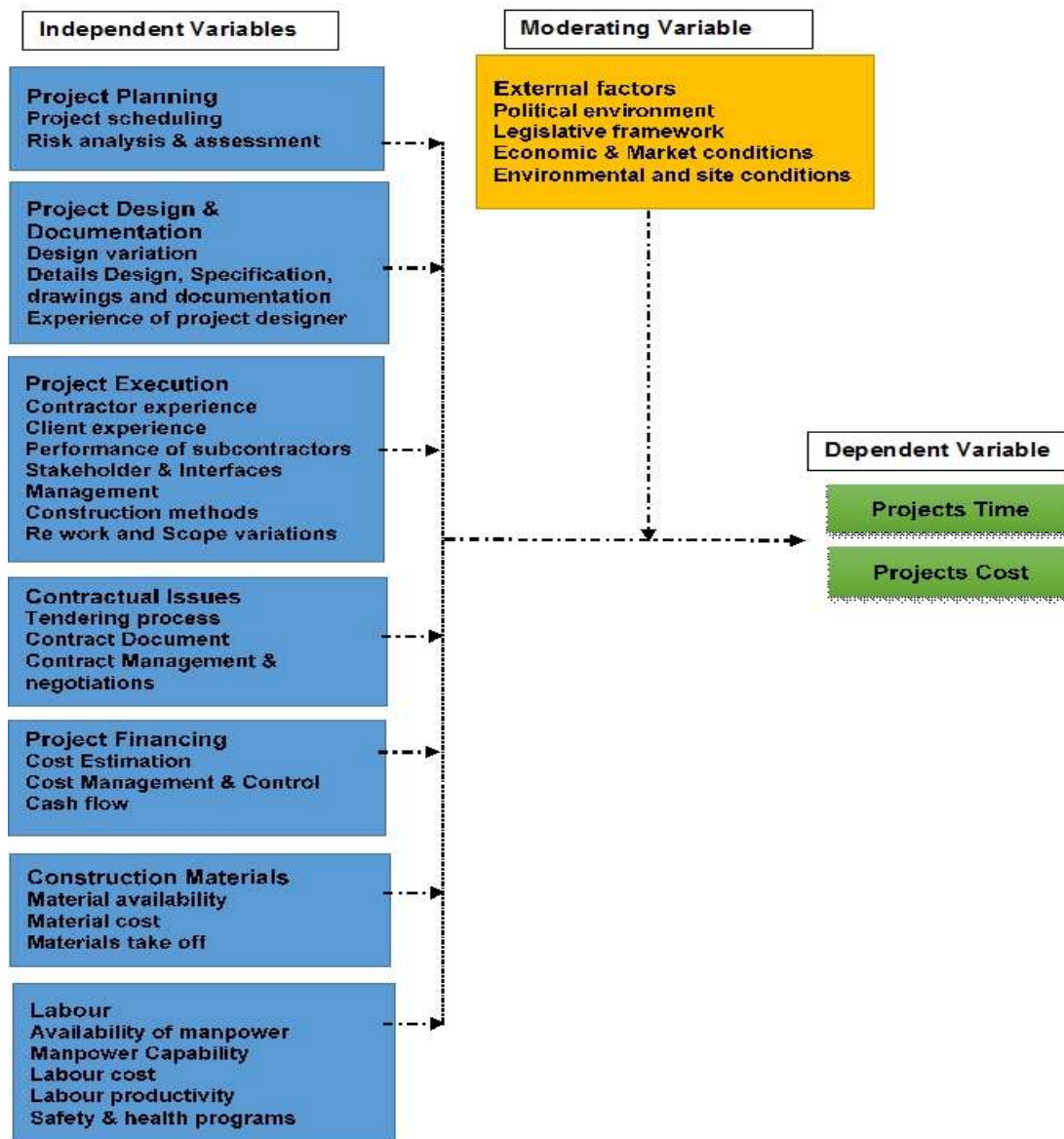
Figure 1: Visualized Conceptual Framework of the Research

ANALYSIS AND DISCUSSION OF FINDINGS

The data analysis process of the collected Data from the questioners' survey is explained in details to identify the main Causes of projects delay and cost overrun in Omani construction industry. The structural relationships between Dependent, Independent and Moderating Variables is analyzed in details by using the structural equation modelling and SMART PLS program is used to draw the structural correlation and relationship between variables.

The Partial Least Square Structural Equation Modelling (PLS-SEM) will be used to analyze the data collected from the survey. PLS-SEM will be used to evaluate the factors that cause projects delay and cost overrun. In addition, this method is used for causal predictive

analysis, including both formative and reflective variables. PLS-SEM is important since it does not require any supposition regarding the distribution of data. PLS-SEM being a multivariate variance method, it is used to calculate variance-based structural equation models, especially in project fields. This study will employ PLS-SEM to solve multifaceted procedure of causal relationships and associations that are difficult to uncover using other methods. The aim of the current study is to utilize PLS-SEM to better understand the construction projects delay and cost overruns influencing factors.

PLS-SEM model

This model will be analyzed in two different phases: first the model that includes constructs or latent variables called Outer Measurement Model, which defines the relationship between latent indicators and their manifest variables, and second, a model that analyzes the relationship between the latent variables known as Inner Structural Model. This study will apply the structural models to evaluate both indirect and direct relationships or influence that one or more independent latent variables have on one or more dependent latent variables (Wong, K. K. K. (2013). PLS-SEM will be used in this study to conduct regression analysis, path analysis, fit model analysis, construct unobservable latent variables, assess model errors in measurement for observed variables, evaluate hypothesized structural linkages that exist between a construct and its corresponding measures and within constructs themselves and statistically test the theoretical models developed. In general, the SEM model will allow the current study to test several relationships at once in a single model with different relationships instead of evaluating each relationship individually.

Evaluation of Outer Measurement model
Reliability and validity of the research instrument

The According to Hair et al. (2013), convergent validity indicates that factors that are indictors of a construct should share a high proportion of variance. Based on this argument, factor loadings were used to measure convergent validity. Hair et al. (2013) proposed that for prove of convergent validity, the factor loadings should be greater than 0.50. From the PLS results, the factor loadings show support for convergent validity for the eight constructs as most of the outer loadings were greater than 0.50. Even though factor loadings with 0.70 and above are considered substantially significant, loadings below can still be considered moderately significant (Hair et al., 2013). Wong, K. K. K. (2013) states 0.70 or higher is preferred, but If it is an exploratory research, 0.4 or higher is acceptable. The high factor loadings in this study provides a reason to conclude that the measures display convergent validity. Similarly,

convergent validity was measured using the Average Variance Extracted (AVE). Fornell & Larcker (1981) stresses that convergent validity of the variables is verified by calculating the Average Variance Extracted (AVE) of the latent constructs. The convergent validity measures the amount of variance that is shown by a construct in relation to the amount of variance as a result of a measurement error and is confirmed where AVE of all constructs is $\geq$0.5 (Hair et al., 2013).

Table 1: Average Variance Extracted (AVE) Values

Construct	AVE
External Factors	0.521
Contractual Issues	0.618
Planning	0.565
Design & Documentation	0.798
Execution	0.936
Financing	0.561
Materials	0.590
Labour & Manpower	0.731
Time & Cost Overruns	1.000000

From the top table, none of the construct latent variables AVE is less than 0.5, they have found to have adequate convergent validity based on the high factor loadings and composite reliability of >0.70 or 0.5 on the lower side (Wong, K. K. K., 2013). These results indicate that convergent validity is confirmed.

The Partial Least Square (PLS) analysis

The PLS model was analyzed and interpreted at two levels: First, was the assessment of the adequacy (quality criteria) of the measurement model and second, the assessment and evaluation of the structural model. The assessment of the measurement model is absolutely necessary and essential to determine the validity and reliability of the scales applied to measure the latent variables and their manifest variables (Hair et al., 2013). The validity of the variables was measured using convergent and discriminant validity and reliability using composite reliability.
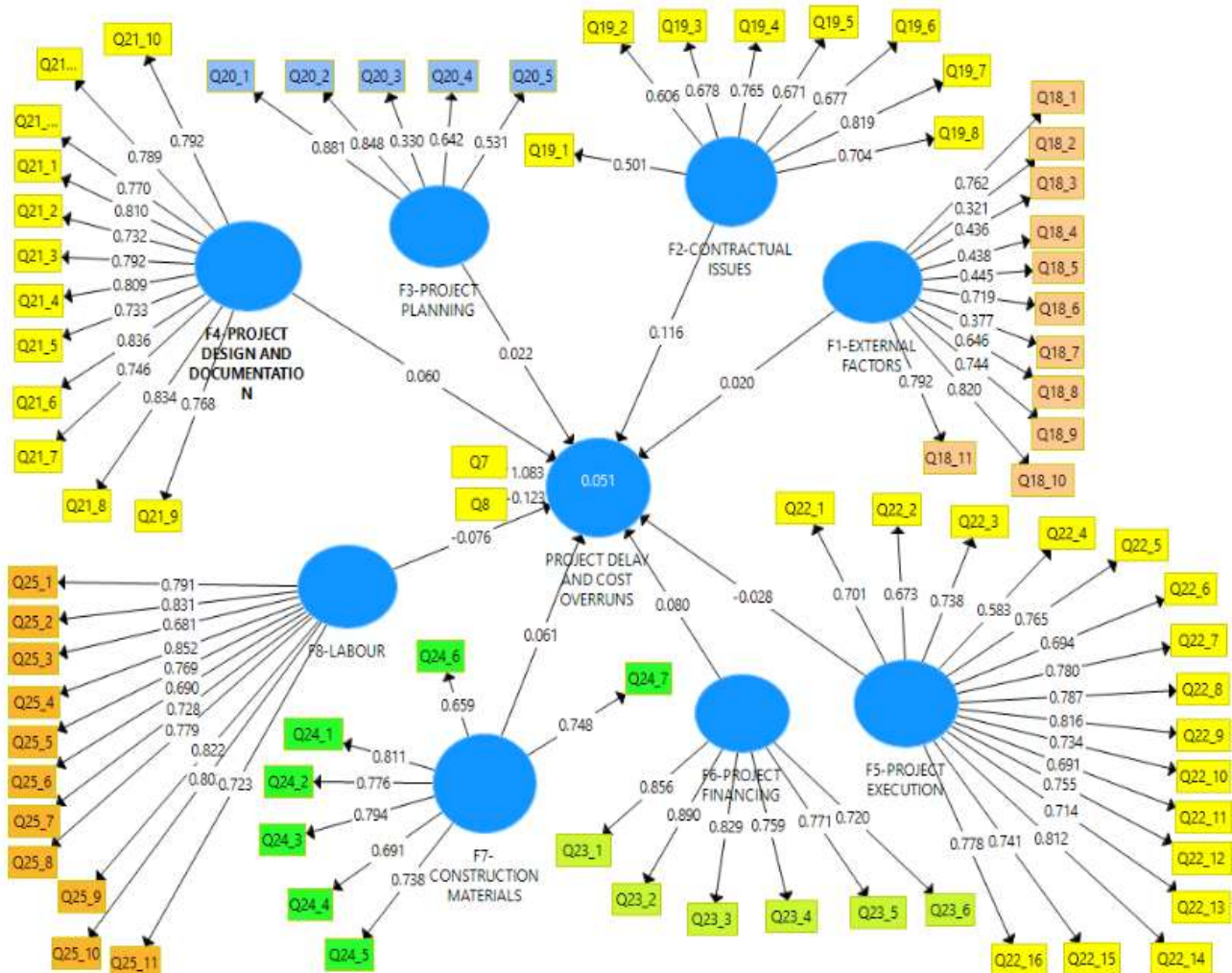
Figure 2: PLS_SEM Output

The causative factors measurement model was developed to understand the size of effect that factors such as contractual issues, planning, design & documentation, execution-related factors, financing, material-related factors and labour and manpower practices, have impact on the project cost and timely completion of construction projects within Oman. In general, the findings indicated that there exists negative and positive significant relationship between the major factors and the project cost overruns and delays. This is consistent with previous studies such as Hashem (2002) who found that the factors listed above including others had huge impact on project cost and delays. The study established that such factors significantly contributed to the increased cost overruns and delays in construction projects. Besides identifying the key factors causing project delays and cost overruns, the study also established the strength of each factor in predicting the variance experienced in project costs and delays.

The findings of this study also indicated that factors including external-related factors had little influence on the cost of a project and delays. The results of Alnuaimi and Al Mohsin (2013) coincides with the study findings which also found that the external & government factors rarely influenced the project cost and that mainly internal factors and more particularly labour & manpower significantly influenced project cost overrun and delays.

Research objective 1

The first objective of the study was to identify the factors that causes cost overrun and delays in Omani construction projects and to evaluate the relationship between latent variables (External factors, contractual issues, planning, design & documentation, execution-related factors, financing, material-related factors and labour and manpower) and the construction project cost and delays in Oman.

The results of the study indicate that more than 76 factors make the long list of causes that project cost and delays. These factors were classified under eight main causes as discussed under data analysis chapter. The results revealed that these factors highly influence the major causes (have high impact size), hence strongly predict the variance in construction project cost and delays. These results are consistent with Alzebdeh et al (2015) study findings who while carrying out factor analysis established that contractual related factors or sub-factors were highly correlated with contractual main factor and have high severity index.

The relationship between major eight factors and project cost overruns and delays was established through computing the significance of the path coefficients, thus testing the hypotheses. The Hypotheses H1 to H8 were tested by examining the significance of the path coefficients using the t-statistic values. Similarly, a t-value greater than or equal to 1.96 was used to confirm each study hypothesis for an alpha level of 0.05 (Hair et al., 2013). Additionally, the paths between the constructs were also scrutinized as presented in the hypothesis testing table below.

It is mentioned that all eight paths were statistically significant because their t-values are greater than 1.96 and their p-values are less than 0.05 (α = 0.05). Thus, the study concludes that all eight latent variables are significantly predict the variance in cost overruns and delays in Omani construction projects.

Table 2: The Hypotheses test results for 8 main causes of projects delay and cost overrun

Hypotheses	Interactions	Path coefficients	Standard Error (STERR)	T Statistics (|O/STERR|)	p-values	Decision
H1	Planning -> Cost Overruns	0.124111	0.130124	1.963788	0.011032892	Supported
H2	Design & Documentation -> Cost Overruns	-0.273578	0.234316	1.960124	0.052858974	Supported
H3	Contractual Issues -> Cost Overruns	0.172978	0.183097	1.964733	0.030452799	Supported
H4	Execution -> Cost Overruns	-0.285544	0.271528	1.971618	0.059840858	Supported
H5	Labour & Manpower -> Cost Overruns	0.297348	0.215748	1.978219	0.015691074	Supported
H6	Materials -> Cost Overruns	-0.143110	0.162238	1.982100	0.043210869	Supported
H7	Financing -> Cost Overruns	-0.151185	0.167737	1.991321	0.014608522	Supported
H8	External Factors -> Cost Overruns	0.128161	0.136146	1.963453	0.012894283	Supported

The first hypothesis H_{1a}, which was suggesting a significant relationship between project planning and cost overrun was supported as the results, revealed that the relationship between project planning and cost overruns and delays was statistically significant. This indicates that poor project planning highly affects the project cost and delays. These findings concur with those of Memon et al. (2010) who conducted a similar study in Malaysia and found that inadequate planning and scheduling significantly influenced project delay and cost overruns.

Equally, while testing the second hypothesis H_{2a}, which sought to prove a significant relationship between design & documentation aspect and cost overruns and delays, the findings indicated that the factor significantly predicted the variance in project cost and delays. These findings matching with the similar previous studies who found that design & documentation related problems were the main causes of cost overruns (Kouski et al., 2004). Thus, the findings

of the study might be attributed to increased number of experts in design as well as application of advanced technology in construction project design.

The research findings also established that (Hypothesis H_{3a}) contractual related issues highly influence cost overrun and delays in Omani construction projects. These findings supported the third hypothesis, which suggested that contractual issues highly predicted the variance in project delays and cost overruns. These results agree with the findings of other studies such as Koushki et al. (2004) conducted in Kuwait, and Memon et al. (2010) carried out in Malaysia, who ranked contractual related issues as the second most influencing factor of cost overruns and delays.

Similarly, the study results revealed a significant relationship between (Hypothesis H_{4a}) project execution and cost overrun and delays in Omani construction projects. The results of Al Saadi et al (2018) identify poor project execution as the main factor contributing to project waste or cost overruns. In his study, project execution is ranked second and third respectively as the major issue causing increased project cost overruns and delays. While testing the hypothesis H_{5a}, which sought to prove a significant relationship between manpower aspect and projects cost overruns and delays, the findings indicated that the factor significantly predicted the variance in project cost and delays. A similar study by Hoai, Lee & Lee (2008) conducted in Vietnam revealed a significant relationship between project design and cost overruns and manpower issues. The study findings also revealed that (Hypothesis H_{6a}) construction material-related factors have immense impact on cost overruns and delays in construction projects done in Oman. These sentiments coincide with studies conducted in Kuwait (Koushki et al., 2004) and Vietnam (Hoai et al., 2008) which discovered that material related issues and shortage of materials as one of the main causes of cost overrun and delays.

Similarly, the study results revealed a significant relationship between (Hypothesis H_{7a}) project financing and construction project cost overruns and delays in Oman, and the results indicated a positive significant relationship between these variables. These findings are consistent with the results of a study conducted in Malaysia by Ramabhadran (2010) who found that client financial difficulties lead to suspension/stoppage of work, labour wastage, machine idling, and severely affects the project cost overruns and delays.

Lastly, in response to the second objective, the study tested the relationship between (Hypothesis H_{8a}) project external related issues and construction project cost overruns and delays in Oman, and the results indicated a positive significant relationship between these variables. These results agree with the findings of other studies of Al Battashi et al (2018), who ranked the external related issues as the highest and most influencing factor of cost overruns and delays.

In general, the study findings reveal that all the eight main factors, revealed a significant relationship with cost overruns and delays in Omani construction projects.

Research Objective 2

Though various studies were conducted to identify the stakeholders responsible of the construction project delays and cost overruns, the respondents were asked to identify the major stakeholders responsible for the delays and cost overruns. The Objective 2 of the study was to identify the stakeholders involved in this process was set. The corresponding hypothesis set for this objective was:

Null Hypothesis: H_{9a}: The Project Delays and cost overruns have positive correlation between the stakeholders involved in the construction projects

Alternate Hypothesis: H_{9b}: The Project Delays and cost overruns have negative correlation between the stakeholders involved in the construction projects

The table shows the ranking of the stakeholder's involvement based on the mean values.

Table 3: Comparative Analysis of stakeholders responsible of project delays and cost overruns

Stakeholder	Mean	Rank
Contractor	2.99	2
Client	2.54	3
Consultant	2.36	4
External Factors	3.22	1

As the respondents were asked to rank 1 – Very High and 5 – Very Low responsible for the project delays and cost overrun.

Figure 3: Person who could be possible reason for projects delay and cost overrun

The figure above shows the respondents opinion on the party responsible for the projects delay and cost overrun. Which indicated clearly that the first party responsible of projects delay and cost overruns was external factor due to the current world health condition COVID 19, world financial crises and significant drop in oil prices. Then the second one was the contractor because he is responsible of construction and delivery of projects, As Jahanger (2013) said, it shall be identified that the Omani construction industries are also getting affected by projects delay and cost overrun caused by the contractors. This finding also matches with Bakr (2015) findings. In most of the cases, the contractors related factors were having high impact on the project delays and cost overruns. Then the client because he is responsible of providing the suitable environment for the succession of the construction projects (from providing sufficient budgets to provide fit for purposes lows and regulations and taking right decisions). The engineering Consultant bear the least but significant (34%) responsibility for the schedule and cost overruns experienced in the Oman construction industry.

Thus, the Hypothesis 9_a: The Project Delays and cost overruns have positive correlation between the stakeholders involved in the construction projects, is true.

Research Objective 3

One of the major objectives of the study was to identify the factors that have highest impact on the construction project delays and cost overruns. The corresponding hypothesis set for measuring this objective:

Null Hypothesis: H_{10a}: The factors influencing project delays and cost overruns have positive correlation with each other

Alternative Hypothesis: H_{10b}: The factors influencing project delays and cost overruns have either no or negative correlation with each other.

The standard PLS-SEM analyses provide information on the relative importance of variables (constructs) in explaining other variables (constructs) in the structural model (Wong, K. K. K. ,2013). This is important in drawing conclusions on how various latent variables (External factors, contractual issues, planning, design & documentation, execution-related factors, financing, material-related factors and labour and manpower) affect the cost overruns and delays in Omani construction projects. Importance-Performance Matrix Analyses (IPMA) was used to obtain the index values for the eight latent variables to show their relative importance and performance in predicting the cost overruns and delays as shown in the table 4.

Table 4: The Rank of main 8 factors to projects delay and cost overrun
by using Index Values for Latent Variables

	LV Index Values	Rank
Contractual Issues	3.250577	6
Design & Documentation	3.308729	5
Execution	3.395065	4
External Factors	3.039109	8
Financing	3.488721	3
Labour & Manpower	3.156595	7
Materials	3.770090	1
Planning	3.751890	2
Time & Cost Overruns	0.315769	

The findings in the index values table above reveal that the most important variable or factor in explaining the variance in cost overruns and delays is material, followed by planning, financing, execution, design and documentation, contractual issues, labour & manpower and external factors.

Research Objective 4

The Fourth objective was to identify the measures that could be used to mitigate the main factors causing increased project delays and cost overruns. The main of aim of this research objective was to propose a mitigation strategy for construction projects managers in Oman and Omani Government leaders and polices and decisions makers to help them combat the growing project cost overruns and delays.

To measure the above objective, the following hypothesis is articulated: Null Hypothesis H_{11a}: The project delays and cost overruns shall be eliminated by proper mitigation strategies.

Alternate Hypothesis: H_{11b}: The project delays and cost overruns could not be eliminated fully by proper mitigation strategies.

The study identified 20 mitigation measures, which were ranked in terms of their relative importance and effectiveness. This study identified standard contractor experience as the most important mitigation measure, followed by soil investigation, early procurement, detailed planning, solving financial disputes, detailed cost estimation and training programs. These results reinforce those of Ramabhadran (2010) who identified training of staff, value management, cost monitoring on tendering and procurement as the most significant mitigation measures.

Table 5: The RII score and the ranking for most of the mitigation measures

Mitigation Measures	RII	Rank
Contractor Experience	0.86769	1
Soil Investigation	0.85385	2
Early Procurement	0.85231	3
Detailed Planning	0.85231	4
Solving Financial Disputes	0.85077	5
Detailed Cost Estimation	0.84154	6
Well Trained Staff	0.83538	7
Tendering Process	0.82154	8
Weather Planning	0.80308	9
Stakeholder Engagement	0.78769	10
Retain Key Staff	0.77538	11
Projects Management Tools	0.77077	12
Tender Board Empowerment	0.73538	13
No scope change	0.71692	14
Strong Governance	0.70615	15
Hedging Policy	0.56769	16
Multiple Currencies	0.55077	17
Risk Register	0.54846	18
Standard Tendering	0.52769	19
Technical Qualification	0.51615	20

As indicated in the table above is over 0.5 indicating that the respondents perceive these mitigation measures to be important in addressing the problem of delays and cost overruns in the Omani construction industry.

The ranking of the mitigation measures based on the RII score is presented in the table 5 the experience of the contractor is critical in mitigating the problem of delays and cost overruns in the Omani construction industry. In this regard, project owners are advised to look at contractor's experience as opposed to the lowest bidder when awarding the contract. Ground investigation before executing the project emerged second in terms of perceived importance in addressing the problem of cost overruns. Adequate ground investigation serves well to foresee impending problems that may hinder execution of the project leading to both time and cost overruns.

As indicated above, early procurement emerged third in the rank of mitigation measures against delays and cost overruns. Early procurement of lead materials helps to reduce waiting time that causes both project delays and cost overruns. Detailed planning emerged fourth in terms

of perceived importance in addressing the problem of delays and cost overruns in the Oman construction industry. Detailed planning helps to identify the contingencies and obstacles that the project management team is likely to face at any stage in the project construction process. This helps the project management team to put in place measures to address those challenges and increase chances of successful project delivery within the budgeted time and cost.

Solving arising disputes concerning the payment of workers emerged fifth. Addressing pay concerns for the workers is important in ensuring smooth running of operations and construction activities. Well-trained project management as well as project team emerged sixth in terms of perceived importance in addressing the problems of details and cost overrun in the construction industry. Having relevant skills is an important aspect in project planning and execution to avoid unnecessary delays and making decisions that may increase the cost of the project.

It is important to note that most of the mitigation measures had a RII score of over 0.5 indicating that respondents perceived the mitigation measures to be important in addressing the problem of time delay and cost overruns in the Omani construction industry. So the, Hypothesis H_{11a}: The project delays and cost overruns shall be eliminated by proper mitigation strategies is true and accepted.

Research Objective 5

This Objective is to measure the impacts of the projects delay and cost overrun on construction industry and in Oman economy and in implementation of Oman development plan Oman Vision 2040. The corresponding hypothesis set for measuring the attainment of the object was:

Null Hypothesis: H_{12a}: The Project Delays and cost overruns have direct impacts on Oman's economy. Alternate Hypothesis: H_{12b}: The project delays and cost overruns have indirect impacts on Oman's economy.

To measure this hypothesis, the respondents were asked to give their opinions on the impact of project delays and cost overruns.

Table 6: Impacts of Project Delays and Cost Overruns to the construction and Oman economy

No	Impacts	Yes	No
1	Is the construction industry is contributing to Oman economic growth, its GDP and implementation of Oman Vision 2040 blueprint strategies?	92%	8%
2	Is the Omani construction industry is facing severe problems due to Projects delay and cost overrun?	94%	6%
3	Is the projects delay and cost overrun is impacting the Oman economic growth, its GDP and implementation of Oman Vision 2040 blueprint strategies?	91%	9%

92% of the respondents agreed that the construction industries contribute to the country's economy. This is evident in the case of Sultanate of Oman also. As, Sultanate of Oman has invested a large amount for industrial and infrastructure development in recent years, these construction activities significantly have very high impact on the country's economic growth. Moreover, 91% of the respondents said that the project delays and cost overruns have very high impact on the country's GDP. Though oil productions have high shares on Oman's GDP (two fifth) the other related works have impacts on GDP.

As, construction plays a vital role in economic zone development and diversification and per Oman vision 2040 areas of focus: manufacturing, transport and tourism, it is evident that the project delays and cost overruns have high impact on the Oman's economy and GDP. It is evident from the analysis shown from various sources[9]. Oman's GDP was $79.28B during the year 2018 which was 12.29% higher than the 2017 GDP, was declined by 2.89% during the year 2019 and it was $76.98B.

Thus, the Hypothesis H_{12a}: The Project Delays and cost overruns have direct impacts on Oman's economy is true and accepted.

CONCLUSIONS

This study identifies and recommends 20 mitigation measures to address the problem of delays and cost overruns in the Oman construction industry. Some of the key the high-ranking mitigation measures in terms of relative importance are discussed as follows:

At the contracting/tendering stage, clients are advised to select the contractor based on expertise and experience and not the lowest bidder. The tendering board should be empowered to ensure effective and reliable tendering process.

At the project planning stage, a detailed project planning should be done in close consultation with the key parties i.e. client, contractor and consultant. Furthermore, the consultant is required to provide a detailed risk register and risk management plan to the client and this should be shared with the contractor as early as possible. The designing, determination of scope and specifications of the project should be completed before tendering to avoid changes that lead to both time and cost overruns.

At the execution stage, the study discourages changes in scope during the construction process. During project execution, all the involved parties i.e. client, contractor and consultant should work in a mutually beneficial relationship to ensure smooth running of construction activities. During execution, the contractor is required to use standard project management tools such as PMO process according to the PMI standards. To ensure that the project adheres to the prescribed industry standards, the contractor is expected to closely liaise with professional

bodies such as the Oman Society of engineers (OSE). At this, changing of key staff such as project manager is discouraged as it may take time for new entrant to understand and implement the project in an appropriate manner.

Other mitigation measures include use of to mitigate foreign currency exchange risks and use of multiple currencies in budgeting and procurement to reduce the risk. Having a clear, detailed cost estimation could help to reduce risks in project financing.

Early procurement for lead items will help to reduce delays. Carrying out soil investigation and geothermal tests to establish the condition of the site before project execution, adequate planning to address adverse weather conditions and natural disasters could also help to reduce delays and cost overruns. Lastly, having well trained project managers and project teams will help project completion within the budget time and cost.

To improve the Oman economy during the current condition of COVID 19 and the oil price collapse, and to implement Oman Vision 2040 effectively the Omani government should focus more on diversification of economic away from oil dependency towards non-oil industries such as construction, infrastructures, manufacturing, logistics, transportation and tourism and to overcome the difficulties of funding for these diversifications and to overcome the difficulties of borrowing more money from worlds banks and neighbors, Oman should depend on its internal resources and its private sectors to share with government to fund these diversifications and Oman should focus more on attracting more foreign capitals investments by leaning the regulations, lows and processes and by privatization some government sectors, industries and services such as Oil, Gas, Petrochemical, Telecommunication, Logistics, Ports, Infrastructures , Electrical Power, Water, Health and Education services. Which will create more job opportunities for Omanisation which required more improvement on educational and development system in Oman to generate more competitive Omanis workforces for job markets. Also to overcome the current conditions of COVID 19 and world economic crises of oil price collapse, Oman government should reduce its expenditures and Operation budgets by taking more strategic decisions by creating a lot of changes in its government organizations set up by making it more lean, fit for purpose, more effective with high productivities based on SMART KPIs.

Contribution of research

This is the first study in identifying the causes of delays and cost overruns in the construction industry of Oman. By recommending mitigation measures for the identified delays and cost overruns, the study contributes significantly to the performance of economic growth in the Sultanate of Oman. The report contributes significantly to successful implementation of the

Sultanate's long term strategic development plan, Oman Vision 2040 and provides specific recommendations to Oman Government leaders, decision & policy makers that can help to improve the economy of Oman during the COVID-19 pandemic and world economic crises of collapse of oil prices.

Limitations of the study

The study involved respondents drawn from all cities in the Sultanate of Oman. The COVID – 19 pandemic made it significantly difficult to find experienced and professional project managers, practitioners and stakeholders in the Omani Construction industry to conduct the survey. However, launching the survey through an electronic online Survey Software (Qualtrics survey Solutions) enhanced participation in the study as the targeted respondents accessed and filled the survey online without any physical interactions.

Having taken a quantitative approach, the study subjected itself to research design limitations, being carried out through a survey with close-ended questions and limited options to respondents to pick options provided based on a five-point Likert scale. This design presents a significant level of inflexibility making it difficult for the respondents to provide detailed explanations about the underlying assumptions, beliefs, norms and cultures that could contribute to delays and cost overruns as it could have been in a qualitative study.

Furthermore, the questionnaire formed long, comprised of 109 questions and this made it significantly challenging participants to start, continue and complete the questionnaire. This led to reduced data used in the study. Out of the 207 responses received, only 130 cases were used as 77 cases were removed from the statistical analysis as they had a significant amount of systematically missing data.

The subject of the study, the causes of delays and cost overrun is a Key Performance Indicator (KPI) in the construction industry. Therefore, the topic is sensitive, as the respondents get jittery to provide the required data such as the extent of delays and cost overruns as high scores is an indictment to the performance, capabilities and reputation of the involved parties i.e. clients, government, consultants and contractors. This affects both the quality and quantity of the data collected for the study.

Areas for further Research

The study was carried out in Oman; its scope can be further extended to other countries in the GCC region to identify causes of delays and cost overruns region-wise recommendations on mitigation measures. This data can also enable inter-country comparisons that lead to better

understanding   of the problem of delays and cost overruns hailing the construction industry in this region.

The study shall also be further extended by using qualitative research method allow for more flexibility to the respondents to provide more detailed explanation of the responses chosen and to give the respondents more opportunity to express their beliefs, insights, cultures and norms that impact the projects delay and cost overrun phenomenon. Also the study can be further extended by selecting any projects in Oman as case study and carry out the detailed investigation on the causes of delay and cost overrun and develop the specific solutions to prevent that delay and cost overrun. This study can be done with the same methodology quantitative approach for only cost overrun or project time delay only.

The study classified causes of delays and cost overruns into 8 major factors and 29 sub-factors. Furthermore, the study identified and ranked the top 20 mitigation measures to address the identified causes of delays and cost overruns in the Omani construction industry. There is need for further studies with narrower scope to study the influence of each of the eight factors on schedule and cost of projects in the construction industry and the appropriate mitigation measures. Narrowing the scope enables researchers to recommend more specific mitigation measures against particular causes of delays and cost overruns in different stages of the construction process.

The findings of this study indicate a higher percentage of projects experiencing delays than the percentage of those experiencing cost overruns. There is need for a detailed investigation to determine the nature of the relationship between delays and cost overruns in the construction industry.

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