MODELING THE FACTORS CAUSING COST OVERRUN IN UAE CONSTRUCTION INDUSTRY

AHMED SALEM AHMED MAREY ALHAMMADI

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ABSTRACT

Construction industry is facing a serious issue of cost overrun throughout the world. In UAE also, this is the crucial issue which is resulted from several factors. For successful construction projects, it is imperative to understand and control the factors causing overrun of the cost. Hence, this study developed a graphical model representing the factors affecting the cost overrun in the UAE construction projects. The study adopted a quantitative approach and collected the through the questionnaire survey and analysed with Partial Least Square Structural Equation Modelling (PLS-SEM) approach using SmartPLS software. Initially, a pilot study was conducted to verify the 27 factors identified from literature and classified into five groups. A panel of 33 experienced construction practitioners confirmed the relevancy of the identified factors with construction industry of the UAE. However, they suggested reforming the groups into three categories. A survey was done by distributing 200 questionnaires where only 116 valid responses were received back. The factors were ranked using average index score as well as PLS-SEM model of factors affecting the cost overrun was developed with SmartPLS software. PLS-SEM involved 4 iterations before the model achieved the measurement evaluation criteria adequacy. The model was evaluated based on hypothesis testing, coefficient of determination, effect size, predictive relevancy and goodness-of-fit (GoF). The results of the criteria evaluations showed that the structural component of the model has achieved the threshold values of the criteria. The overall GoF value of the model was 0.338 which indicates that the model is having medium validating power in explaining the relationship of factors in affecting the cost overrun in UAE construction industry. The model outcomes were verified through interview by seven experienced construction experts. All the seven experts agreed with the ranking in the context of their experiences in handling construction projects in UAE. This model highlights the most influencing factors which cause cost overrun based on the interdependence between the factors. It means controlling critical factors will be helpful in controlling the other factors also. Overall, this model can benefit the practitioners in controlling the cost overrun run issue in the UAE construction industry.

ABSTRAK

Industri pembinaan seringkali menghadapi isu serius mengenai lebihan kos di seluruh dunia. Di UAE juga menghadapi isu ini yang terhasil daripada beberapa faktor. Untuk kejayaan projek pembinaan, adalah penting untuk memahami dan mengawal faktor-faktor yang menyebabkan lebihan kos. Oleh itu, kajian ini telah membangunkan model secara grafik yang mewakili faktor-faktor yang mempengaruhi lebihan kos dalam projek pembinaan di UAE. Kajian ini menggunakan pendekatan kuantitatif dan mengumpul data melalui tinjauan soal selidik dan dianalisis melalui pendekatan Partial Least Square Structural Equation Modelling (PLS-SEM) yang menggunakan perisian SmartPLS. Pada mulanya, kajian rintis telah dijalankan untuk mengesahkan 27 faktor yang dikenal pasti daripada literatur dan dikelaskan kepada lima kumpulan. Panel kajian rintis melibatkan 33 pengamal pembinaan yang berpengalaman untuk mengesahkan perkaitan faktor yang dikenal pasti dengan industri pembinaan UAE. Bagaimanapun, pengamal mencadangkan agar kumpulan itu diubah menjadi tiga kategori saja. Tinjauan sebenar telah dilakukan dengan mengedarkan 200 borang soal selidik di mana hanya 116 jawapan yang sah telah diterima semula. Faktor-faktor tersebut digredkan mengikut skor indeks purata serta membangunkan model PLS-SEM faktor-faktor yang mempengaruhi lebihan kos melalui perisian SmartPLS. Proses PLS-SEM melibatkan 4 iterasi sebelum model mencapai keperluan kriteria penilian pengukuran. Model juga dinilai berdasarkan pengujian hipotesis, koefisien determinasi, ukuran efek, relevansi prediktif, dan goodness-of-fit (GoF). Hasil penilaian kriteria menunjukkan bahwa komponen struktural model telah mencapai kriteria nilai batas ambang. Nilai GoF keseluruhan model adalah 0.338 yang menunjukkan bahwa model memiliki kekuatan validasi sedarhana dalam menjelaskan hubungan faktor-faktor yang mempengaruhi kos lebihan untuk industri konstruksi UAE. Hasil model diverifikasi melalui temubual dengan tujuh ahli pembinaa yang berpengalaman. Semua tujuh ahli setuju dengan pengredan faktor-faktor dalam konteks pengalaman mereka dalam menangani projek pembinaa UAE. Model ini menyingkap faktor-faktor penting terjadinya lebihan kos berdasarkan ketergantungan hubungkait antara faktor-faktor tersebut. Ini bererti mengawal faktor-faktor kritis ini akan membantu dalam mengendalikan faktor-faktor lain juga. Secara keseluruhan, model ini memberi manfaat bagi para pengamal pembinaan dalam mengendalikan masalah lebihan kos di industri pembinaan UAE.

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CHAPTER 1

INTRODUCTION

1.1 Background

Construction industry is significant role player in the individual livelihood of a large part of the population because of infrastructure such as electricity, water supply and treatment, transportation, housing and others. Construction projects are important to economic development, considering assets, employment and capital investment. Construction projects have been regarded as major contributor in the Gross Domestic Product (GDP) of any country. Besides contributing to the GDP, the construction industry provides employment for a large number of skilled and unskilled workers. In order to employ these workers and carry out operations, huge investments are involved in construction projects. Numerous studies have been carried out in the area of business creation and the multiplier effect of the construction industry on other sectors of the economy.

It is noted that failure rate of the projects in construction industry is much higher as compared with other industries because construction industry is subjected to a high number of uncertainties and faces risk throughout the lifecycle (Enshassi *et al*. 2016). It is always experiencing the impact of various challenges which affect its performance and hence management of the construction projects becomes a complicate activity.

The stakeholders involved in construction projects always desire and strive for achieving successful completion of the projects. Success of the project is measured with the help of certain parameters such as project time, cost and quality. It is very common to observe that many of the construction projects could not achieve the desired goal within estimated time, cost and quality (Nega, 2008). Amongst, cost and time parameters are considered as very critical criteria (Ameh *et al*., 2010). This

issue is very common in both developed and developing areas (Kaliba *et al*., 2013). This was confirmed through a study of construction projects 20 areas of the world (comprising of developed and developing areas) indicating that only 10 percent projects are completed within cost (Flyvbjerg *et al*. 2003). The authors highlighted that this problem of cost overrun is very severe and has not been improved since last 70 years.

In a recent study of Pakistan, Memon *et al*., (2019) highlighted that until today, this problem of cost overrun is a serious concerned of the stakeholders involved in construction industry. Rahman *et al*., (2019) studying schedule and cost behaviour of Malaysian construction project summarized that overall cost behaviour in construction projects is very poor which needs serious attention.

Like other countries of the world, construction projects in UAE are also facing the problem of cost overrun. All the stakeholders involved in construction projects should rethink the traditional way cost estimation to bring out a distinction between cost underestimation and final cost overruns (Ahiaga-Dagbui & Smith, 2014). In order to monitor the costs incurred in a construction project, it is paramount that the budgeted or estimated costs are compared to the actual costs incurred for various activities in the project. Furthermore, cost overruns need a comprehensive analysis for the costs at the completion of any project (Allahaim & Liu, 2015). Personnel involved in project management of UAE construction industry intend to mitigate cost overruns in construction projects (Cardenas, Voordijk, & Dewulf, 2017).

Since construction projects have a significant effect on the economy, it is important that the costs incurred in undertaking the projects be monitored and controlled closely. Hence, it is essential that cost overrun issue must be addressed carefully. Thus, this research work is focusing on studying the problems causing cost overrun in construction projects of UAE.

1.2 Problem Statement

Cost overrun means the increased of the actual estimated cost of the construction project. It has become a universal phenomenon which adds pressure to investment decision (Ali & Kamaruzzaman, 2010). Many construction projects being undertaken have been found to take longer than the expected. This resulted more resources than

was planned have to be allocated to the projects and probably for longer than anticipated. Many researchers around the world had investigated the issue of cost overrun and they estimated the percentages distinction between the final completion cost and the contract-bid cost (Frame, 1997; Cantarelli *et al*., 2010; Olawale & Sun, 2010; Omoregie & Radford, 2006; Olatunji, 2008; Franca & Haddad, 2018; Batool & Abbas, 2017; Bentil *et al*., 2017). There are many factors contributed to this predicament including inflation and the increasing cost of production. However, construction projects can be managed in a manner that would see them be completed as scheduled and the cost incurred remain within the budgeted Figures. This problem of cost overrun is results of several factors and it is important to identify factors that contribute to cost overruns to avoid and minimize problems.

With the fastest growing economy, the UAE government is very concerned on social and economic development of its nation. This motivated investors throughout the world to invest in the construction sector of UAE. Even during the economic crisis in 2008, construction industry of UAE attained high growth rate with GDP recorded of 8%. Presently, UAE construction sector is linked with Oil & Gas industry to boost national revenue. There are many mega construction projects executed in near past as well as in current days which include building as well as infrastructural works where professionals from various countries of the world are engaged in practice (Motaleb and Kishk, 2015). Ministry of Infrastructure development UAE has reported that construction industry contributed to 30 to 40 percent of non-oil production sectors (Mahamidet *et al*., 2013). In spite of huge contribution to socioeconomic development, construction industry has faced a serious problem of cost overrun since long time (Faridi & Al-Sayegh, 2006).

Several studies were conducted on UAE construction industry related to cost overrun issue. In a research work conducted to examine the cost performance of construction projects of UAE, Johnson and Babu (2020) reported that main causes of overrun of cost include design variation from client and consultant, poor cost estimation of the project, delay in client's decision-making process, financial constraints of client, inappropriate procurement method, lack of risk management during the execution phase of the project, poor initial planning, lack of client's experience and lack of flexibility in design. Zahmak *et al*. (2020) study found that the contractors believed that cost overrun is resulted due to wrong unit cost of material, poor planning and lack of coordination between the parties while the

consultants argued that cost overrun in construction works of UAE is the result of poor planning, poor productivity and inaccurate quantities. Mishmish and El-Sayegh (2018) claimed that construction projects of UAE affect significantly on project cost and causing cost overrun. According to Al-Hosani *et al*. 2020, construction projects in UAE are suffering severely from cost overrun problem due to delays in decision making by approving authorities, changes in client requirements, construction cost underestimation, poor site management, variation orders and additional works. Previous studies addressing the issue of cost overrun concentrated on identifying and ranking the factors using simple statistical tools. This is not sufficient for making decisions to control cost overrun. It is preferable to prioritise the factors based on interdependence and level of significance. Hence, the main goal of this study was to develop a model explaining the inter-relationship and significance level of the factors in causing cost overrun, in addition to revealing the factors of cost overrun..

1.3 Research Questions

The research questions of this research are as follows:

(i) What are the common factors affecting cost overrun for construction project?
(ii) What is the rank of the common factors affecting UAE construction project?
(iii) How are the structural model factors affecting cost overrun in UAE?
(iv) How does this model assess and validate?

1.4 Aim and Objectives of the Research

The aim of this study is to develop a structural model for examioning the factrs of cost overrun occurring in construction projects in United Arab Emirate. In order to achieve the aim of the study, following objectives were set out:

i. To identify the common factors affecting cost overrun in construction projects
ii. To rank the factors affecting cost overrun in UAE construction projects
iii. To develop a structural model of factors affecting cost overrun in UAE.
iv. To validate the structural model of factors affecting cost overrun

1.5 Scope of the Study

The scope of this research lies within the confines of construction projects in the UAE. The construction projects include the transportation, water supply and sanitation, water resource management, real estate, energy and housing projects. The construction projects in these areas are major contributors to the economic development of UAE and are also a major source of livelihood to a large part of the population. This research work involved quantitative strategy for discovering and evaluating the important factors which cause cost overrun. Gathering data was administrated by using questionnaire form amongst the experts of the construction industry practicing in UAE. The targeted respondents for this study were the practitioners from contractor, consultant and client organization involving in handling the construction projects.

1.6 Significance of the Study

This research seeks to address various challenges that have led to the problem of cost overruns in the construction industry in UAE. Data analysis will result in developing structural model which will be helpful for the practitioners in finding the critical factors of cost overrun. This model identifies the critical factors based on interdependence. In practice, this means that if the most critical factors are under control, the other factors will improve as well. This would be beneficial in seeking the solution for a specific factor to avoid the cost overrun in a project. It also makes various recommendations concerning the control of cost overruns in the construction industry.

1.7 Research Methodology

Literature review aimed to create clear understanding and vision about the concept of cost performance. It also determined common factors experienced globally in causing cost overrun. These factors were investigated to find the relevant factors of cost overrun in relation of construction industry of UAE. This was attained through survey among the experienced construction professionals and analysing the responses of the professional statistically to draw the conclusion and explain the conditions of the construction cost performance in UAE.

1.8 Thesis Layout

This thesis explains the modeling of the factors of cost overrun in construction projects of UAE. Overall write up of this thesis is classified into 6 chapters. Chapter one of the thesis highlighted the fundamental concept and the reasons of carrying out this research project. It also elaborated background of study, objectives of research and the scope of the work. Chapter two focused on reviewing literature related to the study topic. It explained the concept of cost overrun as well as cost overrun issues faced in global construction industry to determine the common factors of cost overrun. Chapter three of this study elaborated the methodology used for carrying out this research work. Main focus of this chapter was to highlight the mode of data collection and explain the methods used for data analysis. Chapter four of the thesis described the results of the data obtained through descriptive analysis. It aimed to rank the factors of the cost overrun used for investigation in determining the critical factors. Chapter five explained the analysis of the data with Structural Equation Modeling (SEM). It elaborated step by step approach of SEM used for analysis as well the validation of the data collection and analysis results. Chapter sic presented the conclusion of this research projects. It highlighted the main findings of the objectives of the study together with the limitation and future directions for further research works to be carried out in near future.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Any construction project cannot be successful unless it achieves its targets within the estimated cost and time period. For this effective project management is very essential where the critical task is to manage the issues faced in managing the required resources. Any lack can create various threats to the construction projects and cause failure. Major challenges faced in construction projects leading to failure are non-completion of activities on time and overrun of the cost. These challenges can cause several harmful situations such as disputed between the stakeholders. Consequently, the quality of the work is also affected. This has emphasized on the importance of the research work in investigating the problems of time and cost overrun in academicians, researchers and practitioners (Ahbab 2012).

Cost overrun is universal issue faced in construction projects around the world Since last 70 years, no considerable improvements has been experienced in overcoming the problem of cost overrun (Flyvbjerg *et al*. 2003). There is, no substantial enhancement or important solution in alleviate its detrimental impacts. Overruns presents a huge degree of the production costs. Various elements affecting cost overrun and higher management should take serious actions on analysing the reasons of cost overrun and controlling those. This chapter discusses in details the construction strategy in UAE and review of factors of cost overrun faced throughout the world.

2.2 Construction Projects in UAE

In recent years, UAE is acknowledged as one of the most fastest growing economies. In UAE, social and economic development of the nation is considered of great importance. This has motivated the investors throughout the globe to invest in the construction industry of UAE. Even during the commercial crush of 2008, construction industry of UAE attained high growth rate and GDP was recorded as 8%. Now days, construction sector of UAE is linked with boosting the revenue through Oil & Gas industry. History of construction activities of UAE reveals that the growth in construction is always significant and this growth was started since 1990s. There are several mega construction projects executed in near past as well as in current days which include building as well as infrastructural works where professionals from various countries of the world are engaged in practice (Motaleb and Kishk, 2015). Ministry of Infrastructure development UAE has reported that construction industry contributed to 30 to 40 percent of non-oil production sectors during the period of 1980 to 2000 as cited by (Mahamidet *et al*. 2013). In spite of huge contribution to socioeconomic development, construction industry has faced a serious problem of cost overrun since long (Faridi and Al-Sayegh, 2006).

After facing series of crises, construction sector of Abu Dhabi has gained its boom again and going through difference stages of project life cycle. Abu Dhabi Executive council demonstrated 2030 vision of the government to make sure the year 2012 with focus on careful assessment of Emirate's plans. As a part of this 2030 vision, various construction projects were launched in 2013. It was declared that representatives of Abu Dhabi government agencies will settle in concerned emirate. Social development was given the major concern of the government and focus was given to development of healthcare facilities and social/national housing plans. Extension of Abu Dhabi International Airport was also given priority and funds were allocated for this project. It was expected that this extension of airport projects would cost AED 25 billion where 700,000 square meter extension to facilitate 27 million passengers annually to lodge. Besides Zayed National Muesum, the Louvere Abu Dhabi and the Guggenheim Abu Dhabi projects were planned to provide world class tourism places to attract the visit from all over the world. In infrastructural development Khalifa port, STRATA, Etihas Rail and project related general road facilities were also given importance (Harris, 2013). In the same, Dubai also proved

regaining its position by launching several projects after the crush of 2008.Various projects which were incomplete earlier were given priority to finalize and various plans were announced to attract the investors from all over the world

2.3 Problem in Construction Projects

Construction industry has always focused on accomplishing the basic needs of human such as need of home, water supply facilities and road network. It also plays vital role in upbringing the economic level of any country (Rahman *et al*. 2019). Huge amount of money is spent on construction throughout the world. But unfortunately, construction projects are facing several challenges such as high amount of resource utilization, negative effect on environment, waste generation, overrun of time and cost (Azis *et al*. 2012). Okoye *et al*. (2015) highlighted that construction projects experience the challenges in meeting the quality standards, uncertainties and complexity which affect the project outcomes very badly. Le-Hoai *et al* (2008) argued that Vietnamese government recognized the issue of time overrun in construction projects as headache. In Malaysia, a study highlighted that only 90% of the projects are completed without experiencing delay (Abdullah 2010). Overrun of time in construction projects is a serious issue (Babu and Raju 2019). Delay in completion of the projects exert pressure on the stakeholders especially the investor and results in huge amount of unrecoverable monetary loss (Rahman *et al*. 2019).

Besides time overrun, waste generation is also a serious issue faced in construction projects. Construction waste generation not only effect on the material and monetary loss but also has severe effect on environment (Akhund *et al*. 2019). Kabirifar*et al*. (2020) cited that 800 Metric Tons of construction and demolition waste is generated in European Union every year. Construction waste problem is of utmost important which needs to be considered at the starting of any project (Xu and Lu). Construction industry is also reported as highly hazardous industry and facing poor safety management especially in developing countries (Othman *et al*. 2020). Every year a significant number of deadly fatalities and accidents are reported in construction industry (Sanni-Anibire *et al*. 2020).

Among these problems, cost overrun is a very serious issue which needs careful attention. Babu and Raju (2019) mentioned that cost overrun in experienced in every project that might be complex or even simple project. The problem of cost

overrun in not new but has remained major concern of the practitioners since long time. A research work carried out in different geographical area of the globe revealed that 90% of the construction projects face overrun and this problem of overrun has remained in same trained for more than last 70 years (Flyvbjerg *et al*. 2003). This has emphasised on paying attention to understand and resolve the issue of cost overrun as it will effect on the overall project budget as well the economy of the country.

2.4 Cost Overrun in Construction Industry

Cost overrun is termed as cost increase or budget overrun. Cost overrun is the surplus of actual cost over budgeted cost. It has become a universal phenomenon which adds pressure to investment decision (Ali & Kamaruzzaman, 2010). Cost overrun is a percentage of the difference between the final cost of completion and contract-bid cost. Cost overrun is also indicated by the percentage of actual or final cost above the expected or tender cost of the project. Frame (1997) investigating 8000 projects, draw attention to the performance and mentioned that 84% of the projects failed in achieving completion within estimated time, cost and also quality requirement in USA while Government Accountability Office of USA stated that only 23% of the highway projects of USA could be completed within cost (Cantarelli *et al*., 2010).

A survey revealed that poor time and cost performance was a common issue where only 41% respondents mentioned that cost overrun in their projects was less than 10% otherwise it was more than 10%, on the other hand only 38% respondents faced overrun of time less than 10% and 62% respondents had experience time overrun of more than 10% (Olawale & Sun, 2010). Omoregie & Radford (2006) argued that in projects 14% for escalation should be added to avoid budget overrun. Because of poor performance, 45% project of 137 investigated projects had undergone cost overrun with minimum overrun of 5% to maximum 808% (Olatunji, 2008). Construction projects face poor cost performance where 71% of 238 projects considered in investigation had exceeded their cost by 82% in Brazil (Franca & Haddad, 2018). Investigation of Hydro Power projects initiated by Water and Power Development Authority (WAPDA) of Pakistan revealed the projects were completed with spending excessive time of 200% times the contract time while 2.5% overrun of budget was reported (Batool & Abbas, 2017). A survey in Ghana to understand time and cost performance of construction projects reported that more than 40% exceeded

than contract time and cost. Study revealed that average cost and time overrun were 75% and 146% while maximum overrun of cost and time were 376% and 400% respectively (Bentil *et al*., 2017). Morris (1990) studying 290 medium & large on-going construction projects in the Public Sector with a cost of Rs. 20 crores or more reported that 186 had cost overruns with percentage cost overrun as much as 50%. Brazil's 238 construction projects under investigation showed a cost overrun of 82% (França and Haddad, 2018).

2.5 Factors Affecting Cost Overrun in Construction Projects

Poor performance of time and cost in the construction industry has been a major issue for a long time. It's a global phenomenon (Le-Hoai *et al*., 2008). This problem of cost overrun is results of several factors and it is important to identify factors that contribute to cost overruns to avoid and minimize problems (Azhar *et al*., 2008). Hence, it is very essential to study cost overrun problem in depth to avoid overrun and achieve successful projects. To avoid construction cost overrun, very first and most important step is to identify and understand the causative factors responsible for cost overrun (Memon *et al*., 2011). Memon *et al*. (2019) emphasised that poor cost performance is a prominent challenge for practitioners involved in construction industry which must be give serious attention. Numerous researchers have worked on underpinning those factors for long time as presented in following sub-sections.

2.5.1 Global Perspective

Okpala & Aniekwu (1988) conducted a questionnaire survey amongst the professionals involved in construction projects and found that delays and cost overrun are major issues of construction project which are caused by several factors where the significant factors are shortage of materials, financing, and payments for completed works and poor contract management.

Moris (1990) pointed out that the important factors which are responsible for cost overrun are majority related to enterprise such as planning, management and technical skills. A study of UK construction industry revealed that design changes and design development factors, information availability and methods of estimation are very significant indicators of cost overrun (Jackson, 2002). On the other hand,

Frimpong *et al*. (2003) investigating construction industry of Ghana highlighted that monthly payment difficulties, poor contract management, material procurement, inflation and contractor's financial difficulties are critical issue in causing cost overrun. Vietnamese construction industry also faced the problem of cost overrun severely due to several reasons such as poor site management and supervision, poor project management assistance, financial difficulties of owner and financial difficulties of contractors (Le-Hoai *et al*. 2008). Construction industry of Gaza also experienced cost overrun problem due to poor cost performance. This poor poor performance was resulted due to increment in material price, delay in construction, supply of material and equipment, fluctuation in the price of materials, unsettlement of local currency in relation to dollar and monopoly of material suppliers.

Ali and Kamaruzzaman (2010) investigated large projects in Klang Valley of Malaysia and reported that inaccurate or poor estimation, inflation of project costs, improper planning, fluctuation in price of materials and poor project management are responsible causes of cost overrun. Olawale and Sun (2010) identified factors hindering project cost performance in construction sector of UK where design changes, risk and uncertainty, inaccurate evaluation of time, non-performance of sub-contractors and nominated suppliers are reported as major factors. Conflicts among the stakeholder, lack of knowledge, poor project specific attributes, lack of cooperation and hostile socio-economic and climatic conditions are reported as critical causes affecting cost performance in construction works of India (Iyer and Jha 2010).

Apolot *et al*., (2011) highlighted five factors having high impact on cost overrun include changes in work scope, inflation and high interest rates, fuel shortage, poor monitoring and control, and delayed payment to the contractors. Memon *et al*., (2011) listed 78 factors of cost overrun through literature review and conducted a survey amongst the selected experienced personnel for expert opinion to find the factors relevant of Malaysian construction industry. Among the recognized that design related issues, contract time duration, contractor's experience, issues related to arrangements of resources, lacking in planning and scheduling are major reasons of cost overrun. Further, the authors reported that cost performance can be improved by enhancing the relationship between the stakeholder especially management and labour. Cha and Shin (2011) studied the performance of

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