Causes of Cost Overruns in Saudi Arabia Construction Projects vs. PIPS: A University Case Study

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Abstract
Public projects in Saudi Arabia have been experiencing low construction project performance for the past decade. Studies have identified the low-bid delivery method as an important factor in causing such delays. A case study was conducted at a university campus in northern Saudi Arabia to identify causes of cost overruns via interviewed project representatives. In addition, a large survey was conducted of 804 classified contractors and university representatives who identified change orders as the most common factor causing cost overruns in Saudi Arabia. Previous studies showed that some contractors aim to submit low bids to win the competition, and then change orders to reduce their losses. Consequently, low bids also lead to cost overruns. In a comparison using the result of a case study and the results of the Performance Information Procurement System (PIPS), Saudi Arabia's delivery system was identified as a potential cause of project performance issues.

Keywords
Performance, cost overruns, low-bid, Saudi Arabia, Best Value Performance Information Procurement System (BV PIPS).

1. Introduction

The Saudi construction industry has been developing since the establishment of Saudi Arabia, and its developments have only increased in recent years. From 1990 to 2000, investment funds in the Saudi construction industry totaled $234 billion US (Cordesman, 2002). In 2015, the total cost of construction contracts was about $32 billion US (Ministry of Finance, 2015). As shown above, the government of Saudi Arabia has pumped billions of dollars into the construction industry. However, it was found that 70% of public projects were delayed (Assaf and Al-Hejji, 2006). One of the important factors for the delays mentioned in previous studies was the low-bid procurement system. Most Middle Eastern countries used the lowest-bidding company, which is regarded as being the primary cause of construction delays in Saudi Arabia (Albogamy *et al.*, 2013; Al-Khalil and Al-Ghafly, 1999; Mahamid, 2013; Alzara *et al.*, 2016). In other words, contractors were selected based on price alone, a process that ignored the

contractors' past performance. In addition to construction project delays, there were also cost overrun problems. This study investigates causes of cost overruns in contractors using a low-bid method in a case study focusing on a new university campus located in northern Saudi Arabia. This university was established in 2005 and has been in the construction stage since 2006.

2. Problem

The procurement delivery system in Saudi Arabia is based primarily on low bidding prices. When contractors are selected, the only focus is price. These low-bid projects are affected by substandard performance and delays, which often lead to increased costs. The government of Saudi Arabia has spent billions of US dollars on construction projects, and it selects contractors who give the lowest bid. However, these projects are often affected by cost overruns. This shows a contradiction in the way that contractors are selected because the system relies on cost criteria, but this leads to additional spending during the execution phase. The case study of a new university campus shows substandard performance during construction, which should have been completed in 2012. The delays ranged from 50 to 150% among different campus buildings (Alzara *et al.*, 2016). The procurement delivery system in Saudi Arabia should be reconsidered to increase project performance and save money.

□ Research Questions

What are risk factors that cause cost overruns in construction projects in Saudi Arabia?
How does the Performance Information Procurement System (PIPS) deliver quality projects on time and within budget?

□ Objective of the Study

The objective of this study is to persuade stakeholders in Saudi Arabia that the low-bid procurement delivery system leads to substandard construction performance and cost overruns.

5. Methodology

This study discovered a relationship between low-price bidders and cost overruns through a literature review. It identified the Performance Information Procurement System (PIPS) as solution, which has a high level of performance with no cost deviation. A project director and five engineers at the new university were interviewed, disclosed their method for selecting contractors and identified causes of cost overruns. Then, when the causes of cost overruns were found, 804 classified contractors and representatives of universities were surveyed regarding the causes of the cost overruns. Statistical analysis was conducted for the survey data. The results of the survey were compared with the performance results of the PIPS. The conclusion showed important causes of cost overruns in Saudi Arabia and how PIPS can minimize these causes.

6. Literature Review

Construction projects in Saudi Arabia have long faced issues regarding low performance. Of public construction projects in Saudi Arabia, 70% have experienced delays (Al-Sultan, 1987; Assaf and Al-Hejji, 2006). Previous studies found that the major cause of delays in construction projects in Saudi Arabia is the use of a bid delivery system based on low prices (Albogamy *et al.*, 2013; Al-Khalil and Al-Ghafly, 1999; Assaf and Al-Hejji, 2006; Mahamid, 2013). The most significant factor is the selection of contractors according to the lowest bid in terms of construction (Moore, 1985). Project time and quality are seen as unimportant in comparison (Herbsman and Ellis, 1992). In addition, it was found that the selection of eligible contractors from other bidders, regardless of the lowest bid, could have a positive impact on project cost and performance (Iyer and Jha, 2005). However, a delivery system based on only

price encouraged unqualified contractors to submit bids (Herbsman and Ellis, 1992). This could lead to cost overruns. Experts in the construction industry found that the method of contractor selection in Saudi Arabia often failed to meet owner expectations, which has been proven through the many problems reported, such as contractor failure, cost overruns, increasing changes, poor quality, and claims (Abu Nemeh, 2012). According to Al-Hazmi (1987), cost overruns, order modifications, substandard quality, and contractor insolvency are caused when contractors win the bid by submitting the lowest price (Al-Hazmi, 1987). In addition, it was found that bidders aim to win by providing the lowest cost when the bid is based on price (Cheng, 2008). Contractors who select bids based on the lowest price face profit risk and loss risk (Chao and Liou, 2007). In a low-bid procurement delivery system, bidders have used many techniques to win bidding competitions. For example It was discovered that bidding documents are inspected by some bidders to discover mistakes that will assist them in changing orders and claims if they have projects in the future (Doyle and DeStephanis, 1990). Therefore, the actual costs are not reflected in abnormally low bids due to the many changes in orders and claims that bidders will make later (Bedford, 2009). This is but one method that contractors use to offset their losses when they win contracts through low bids (Zack, 1993); however, this and other methods affect project quality. Another procurement system, best value procurement (BVP), can be used instead to improve project performance. BVP has proven performance in leading to quality construction projects. In this strategy, contractors are selected based on high past performance and lowest price. Then contractors move to the important clarification phase, in which all the details of a proposal are explained, including delivery information, through a specific technique (Kashiwagi and Kashiwagi, 2011). This clarification phase will be explained in the Best Value Case Studies section below. In addition, a previous study identified major delay risk factors for poor performance in Saudi Arabia and identified BV PIPS as a solution for overcoming delay risk factors (Alzara *et al.*, 2016).

6.1 Best Value Case Studies

In 1991, the Best Value Approach (BVA) was instituted by Dr. Dean Kashiwagi at Arizona State University (ASU). The BVA has proven that the utilization of experts can both increase project performance and minimize risks. Logic and common sense are considered to be the principles of BVA, through which decision making, management, and control can be minimized. The industry structure model shows that projects obtain high levels of performance when value based and experience substandard performance when piece based. Then the Best Value Procurement/Performance Information Procurement System (BVP/PIPS), developed by Dr. Kashiwagi's team at ASU, is the Performance Based
Studies Research Group (PBSRG). PIPS works by finding expert contractors and increasing project performance. Construction projects completed according to PIPS were completed on time, with a high level of quality, and completed on budget. PIPS was checked over 1,750 times in projects that amounted to $6.3 billion, with $4 billion of these projects in the construction sector. These projects had a 98% rate of success in six diverse countries and 31 states (Kashiwagi, 2014).

The PIPS process involves four phases: pre-qualification (optional), selection, clarification, and execution. In the clarification phase, vendors are educated regarding BVA and submit dominant metrics to prove vendor performance. The second phase, selection, has four filters to find an appropriate vendor for a project: project capability, interview, prioritize (identify best value), and dominance check for an appropriate vendor. The third phase is clarification, which is considered to be the most significant phase. A vendor should provide a plan for a project from the beginning to the end, including detailed technical specifications, a milestone schedule, the project scope, and a risk management plan. In the final execution phase, a vendor must deliver a Weekly Risk Report (WRR) and a Director's Report (DR) to an owner. WRR and DR are Excel documents that show a milestone schedule, a risk management plan, and performance measurements.

The PIPS process has proven successful when applied. Table 3 displays case studies that have applied PIPS, showing that 100% of those projects finished within their budgets. In these case studies, BVA and

PIPS used many phases and filters to find expert contractors with high levels of performance. Moreover, most of these projects also finished on time. There were no changes to orders, and these projects received a high percentage of overall satisfaction from the project owners. For these case studies, PIPS considered both cost and performance when selecting a contractor rather than price only (Kashiwagi, 2010, 2011).

Table 3: Examples of PIPS Case Studies

Case studies / Criteria	United Airlines	Utah	The University of Hawaii	Minnesota
Duration of execution	1996-1998	1999-2011	2000-2005	2005-present
Number of projects	32	4	11	247
Cost	$13 million	$64,405,100	$1,658,192	$97.2 million
Overall satisfaction	100%	N/A	92%	95%
On time	98%	100%	100%	100%
On budget	100%	100%	100%	100%
Change orders	0%	0%	N/A	0%

(adapted from Kashiwagi, 2014)

7. A New University Case Study

The new university campus selected for this case study is located in northern Saudi Arabia. Its campus comprises 21 colleges in addition to other facilities and serves approximately 26,000 students. The university campus required a number of construction stages to be completed. It was found that, of 22 construction projects, 17 were delayed. The new university campus should have been completed in 2012; however, only two buildings were operational as of 2015. In April 2015, data were collected from the new university to identify cost overruns when the criteria for selecting contractors were based on price alone. The delivery system at the university is based on the low-bid method. A project director and five engineers at the new university were interviewed, and they mentioned that there were cost overruns in university construction projects. In addition, they identified seven risk factors that could cause cost overruns in Saudi Arabia. These seven risk factors were changing orders, proposal errors, contractor's errors, consultant's errors, client's orders, dividing bids into several parts, and unforeseen risks.

8. Survey and Statistical Analysis

Surveys were sent to more than 1,500 classified contractors and 14 project departments of universities in Saudi Arabia for rating the seven risk factors that cause cost overruns. The survey was responded to by 761 classified contractors and 43 representatives of universities.

Validity: The construct validity was used to assess the validity of the cost overrun causes in new Saudi Arabian universities. Generally, a correlation value of 0.70 or higher reflects a strong (high) relationship, and, consequently, the item is considered to be consistent with the total of the items. The correlation values shown in Table 1 reflect a very strong relationship between each item of the cost overrun and the total of the items, suggesting very satisfactory construct validity. All the values were statistically significant at 0.05 and 0.01 levels. Note that most of the values provided in the table were close to the integer 1, which represents the maximum possible value a relationship may reach. The minimum correlation (but considered to express high correlation) value was observed between item no. 1 (Changing Orders) and the cost overrun (0.841). A value of 0.70 or higher is considered to express a strong relationship.

Table 1: The Construct Validity for the Cost Overrun (All Sample n=804)

Item No.	Cost Overrun Causes	Overall Cost Overrun Causes

1	Changing Orders	0.841
2	Proposal Errors	0.888
3	Contractor's Errors	0.884
4	Consultant's Errors	0.911
5	Client's Orders	0.890
6	Dividing Bids into Several Parts	0.949
7	Unforeseen Risks	0.948

Reliability: The approach of internal consistency for Cronbach's alpha was used to describe how much the items of the cost overrun were reliable to measure these causes. This approach is based on calculating the ratio of the sum of item variance to the variance representing the total items and adjusting the answer to the number of items. The value of the internal consistency with regard to seven factors of cost overruns is 0.960, which suggests strong reliability. A value of 0.60 or greater expresses good reliability, so the provided values express a high degree of consistency (here, also, the maximum possible value that may be obtained is 1).

Prioritizing causes of cost overruns: The following formulas were used to calculate the included statistical indices of the mean, the standard deviation, and frequency index (F.I.), which is the percentage of the mean being assessed out of the highest response weight. Table 2 reflects the descriptive statistics for the cost overrun causes for new Saudi Arabian university projects from the perspectives of the contractors and university representatives. The results show that item no. 1 (Changing Orders) is ranked first, as it recorded the greatest FI (89.1), while item no. 3 (Contractor's Errors) is ranked last, as it recorded the lowest FI (59.2). All other values ranged between these two values.

Table 2: Descriptive Statistics for the Causes of Cost Overruns Arranged in Descending Order (Contractors and University Representatives n=804)

Cause Code	Item	Frequency %			Mean	Sd	FI*	Order
		Not Common (1)	**Don't Know (5)**	**Common (10)**				
1	Changing Orders	5.2	12.4	82.3	8.91	2.48	89.1	1
5	Client's Orders	6.5	16.0	77.5	8.62	2.71	86.2	2
2	Proposal Errors	8.6	12.7	78.7	8.59	2.86	85.9	3
7	Unforeseen Risks	14.9	34.6	50.5	6.93	3.36	69.3	4
4	Consultant's Errors	11.1	41.8	47.1	6.91	3.15	69.1	5
6	Divide Bids into Several Parts	14.9	35.4	49.6	6.88	3.36	68.8	6
3	Contractor's Errors	23.9	38.7	37.4	5.92	3.52	59.2	7

(*) mean percentage out of the maximum weight (10)

10. Conclusion

The low-bid method and its results lead to significant costs for the Saudi Arabian government because lowest bids rely on price criteria. In specific cases involving a new university, the projects incurred cost overruns. Change orders, a client's orders, and proposal errors are the most common causes of cost overruns in Saudi Arabia. Conversely, BV PIPS display a high level of construction performance with 100% of such projects staying within budget and being completed on time with 0% change orders (Kashiwagi, 2014). PIPS has demonstrated its ability to locate expert contractors with high performance and the lowest price. This study recommends an adjustment of the current procurement model to run projects in Saudi Arabia using the BV PIPS.

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