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. In addition, low bids for contracts have not reflected the actual project cost. A case study was conducted at a university campus in northern Saudi Arabia in which the actual project costs for four projects were examined. The study found that all four projects’ costs were higher than the original bid. In addition, a large survey was conducted of 804 classified contractors and universities 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 for winning the competition 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: cost, overruns, low-bid, Saudi Arabia, Best Value Performance Information Procurement System (BV PIPS).

Introduction

The Saudi construction industry has been developing since the establishment of Saudi Arabia, and the developments have only increased in recent years. From 1990 to 2000, investment funds in the Saudi construction industry totaled $234 billion (Cordesman, 2002). In 2013, US$48 billion was specified for construction projects via the Saudi Ministry of Finance. In addition, in 2014, it was found that more than $66 billion had been anticipated by the government for projects (Arab News, 2014). In 2015, the total cost of construction contracts was about $32 billion (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 & Al-Hejji, 2006). According to Arab News (2011), nonperformance in terms of construction projects put more than $147 billion at stake. In 1983, 70% of the public projects under the Ministry of Housing and Public Works were delayed (Zain Al-Abedien, 1983). 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 & Al-Ghaflly, 1999; Mahamid, 2013; Alzara et al, 2016). In other words, contractors were selected based on price alone, ignoring contractor’s performance side. In addition to the construction project delays, there were also cost overrun problems. This study investigates the selection of contractors using a low-bid method and cost overruns in a case
study focusing on a new university campus located in northern Saudi Arabia. The new university was established in 2005 and has been in the construction stage since 2006.

**Problem**

Compared to other countries, 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 leads to increased costs. The government of Saudi Arabia has spent billions of dollars on construction projects, and they select contractors according to 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 range 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 Hypothesis**

The criterion of selecting contractors based on the lowest bid does not reflect the true price of projects. Also, the current project management methodology of the new university’s owner uses has led to cost overruns.

**Objective**

The objective of this study is to persuade stakeholders in Saudi Arabia that selecting contractors based on price criterion alone costs the government more due to substandard construction performance and cost overruns.

**Methodology**

In this study was discovered a relationship between low-price bidders and cost overruns through a literature review. The case study was conducted at the new university in northern Saudi Arabia, which uses the low-bid system. Data were collected that included only projects that have complete information available about bidders and cost overruns. Four construction projects were selected for which the complete data could be analyzed to examine cost overruns and show that the actual costs were higher than the original proposed prices. After this, a project director and five engineers at the university were interviewed. They outlined their method for selecting contractors and identified the causes of the cost overruns. Once these causes had been found, 804 classified contractors and representatives of universities were surveyed regarding the general causes of cost overruns. A statistical analysis of the survey data was conducted. Next, the study explained how the Performance Information Procurement System (PIPS) works and discussed some case studies that used PIPS, which approved a high level of performance with no cost.
deviation. In comparing these PIPS case studies with case studies from new university, the criteria of the low-bid procurement delivery system used in Saudi Arabia conflict with the desired results.

**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 & Al-Hejji, 2006; Zain Al-Abedien, 1983). 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 & Al-Ghaflly, 1999; Assaf & Al-Hejji, 2006; Mahamid, 2013). The most significant factor is the selection of contractors according to the lowest bid in terms of construction (Banaitiene & Banaitis, 2006; Hatush & Skitmore, 1997a; Holt, Olomolaiye, & Harris, 1995; Huang, 2011; Merna & Smith, 1990; Moore, 1985; Ng & Skitmore, 2001; Plebankiewicz, 2008, 2010; Singh & Tiong, 2006; Waara & Brochner, 2006). Project time and quality are unimportant in comparison (Herbsman & Ellis, 1992). Hence, project performance is affected when contractors are chosen based on the lowest price while disregarding quality and time (Holt, Olomolaiye, & Harris, 1994).

A study conducted in the United Kingdom, that encouraged the conversion from selecting contractors according to a low-bid delivery system to a performance-based norm, showed that the price of bids was not significant (Wong, Holt, & Cooper, 2000). 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 & Jha, 2005). However, when the delivery system was based on only price, it encouraged unqualified contractors to submit bids (Herbsman & Ellis, 1992). Therefore, construction projects were affected by cost overruns and project delays due to the rewarding of projects to unqualified contractors (Koushki, Al-Rashid, & Kartam, 2005).

According to Banaitiene and Banaitis (2006), the selection of unqualified contractors causes price changes and increases the cost of projects. However, the appropriate awarding of construction projects to qualified contractors can increase project success (Alhazmi & McCaffer, 2000). This has also been confirmed by other studies (Plebankiewicz, 2009). The selection of contractors is, however, considered to be complex (Sari & El-Sayegh, 2007), and project holders face difficulties when they make the decision to select appropriate contractors (Hatush & Skitmore, 1997b). Likewise, it was found that contractor selection in Saudi Arabia is a challenge for project owners due to the fact that it will subsequently affect project accomplishment and the level of satisfaction (Price & Al-Otaibi, 2010).

Experts in the construction industry have found that the method of contractor selection in Saudi Arabia often fails 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). Another study showed that, in the public sector, the selection of qualified contractors is further affected by obstacles such as a lack of capable consultants, difficulty making decisions due to a lack of experience, and organizational stress regarding
achieving the targeted budget within the allotted timeframe (Al-Busaad, 1997). 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). Hence, there exists the possibility that the actual cost of projects is not being represented if a cost-based contractor selection method is applied (Olaniran, 2015). One study showed that a bidder who has the lowest bid frequently provides an estimate that is lower than the appraised cost of the project (Capen, Clapp, & Campbell, 1971). Contractors, who select bids based on the lowest price, face profit risk and loss risk (Chao & Liou, 2007). Moreover, the bidder with lowest price should commit to the implementation of a project despite other bidders do not accept the project at that price (Wolfsetter, 1996). In a low-bid procurement delivery system, bidders have used many techniques to win bidding competitions. It was discovered that some bidders inspect bidding documents to discover mistakes that will assist them in change orders and claims if they have projects in the future (Doyle & DeStephanis, 1990).

Predatory bidding is a term that refers to bidders who use low bids to win projects and subsequently make changes to project instructions and claims to reduce their losses (Crowley & Hancher, 1995). Therefore, the actual costs are not reflected in abnormally low bids due to the many changes in orders and claims that bidders will focus on (Bedford, 2009). This is one method that contractors use to offset their losses when they win contracts through low bids (Zack, 1993). Olaniran (2015) conducted an online questionnaire and surveyed 54 construction practitioners. One of his research goals focused on identifying reasons for project performance problems caused by cost-based contractor selection. His study uncovered 22 reasons; the highest-ranked reason, with a significance index of 78.93, was that contractors reduced their profit margins. The next reason, with a significance index of 59.39, was the poor level of project monitoring and control engaged in by many contractors. The third reason was contractor incompetence, with a significance index of 57.16 (Olaniran, 2015). However, project quality can be affected over the long term when contractors reduce profit margins, which can lead to substandard performance (Han, Park, Kim, Kim, & Kang, 2007).

Rather than using the low-bid system, another procurement system, best value procurement (BVP), can be used to improve project performance. BVP has proven performance in leading to quality construction projects. In this strategy, contractors are selected based on high 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 & Kashiwagi, 2011). The clarification phase will be explained in the best value case studies section. 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).

A New University Case Study

The new university campus selected for this case study is in northern Saudi Arabia. This campus consists of 21 colleges in addition to other facilities and serves approximately 26,000 students. The university campus required several 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. This study concentrated on obtaining complete data regarding projects from the beginning of the project to the current period. It was found that only four projects contained complete project information. That difficulty in collecting data existed because the university’s construction projects had transitioned through many stages and various responsible authorities since their execution in 2006. The four case studies showed all bidder costs for each project and which contractors had been selected. Moreover, the data contained the actual costs obtained during the execution phase. All personal information regarding the contractors, including their names, was coded for this study.

In case study one, there were five bidders. The lowest bid came from Cont AAAFS at $31,605,544, and the highest was provided by Cont AAMASC at $59,333,506. The budget of project one was $34,538,933. In this example, the lowest bid won the project. When the final data were collected, the actual project only reached 24% completion and the actual price was $38,666,667, as shown in Table 1.

Table 1: Data Regarding Case Study One.

| Bidders       | Cost       | Result     | Budget of project | Actual value at 24% completion | Percent of cost deviation |
|---------------|------------|------------|-------------------|--------------------------------|----------------------------|
| Cont AAAFS    | $31,605,544| Selected   | $34,538,933       | $38,666,667                    | 22.3%                      |
| Cont ATCCSA   | $42,185,088|            |                   |                                |                            |
| Cont FTCC     | $44,368,791|            |                   |                                |                            |
| Cont WIAC     | $47,940,058|            |                   |                                |                            |
| Cont AAMASC   | $59,333,506|            |                   |                                |                            |

In case study two, five bidders applied. The lowest bid, provided by Cont AMG, was $24,645,130, whereas the highest bid, provided by Cont AAU, was $40,678,645. However, the lowest and second-lowest bidders left the competition with bids of $40,678,645 and $35,422,798, respectively. Then, from the three remaining contractors, the project owner selected the lowest bid, which was provided by Cont SACC at $37,317,248. However, the budget for project two was $35,733,333. After negotiations between the project owner and contractor, they signed the contract with a price of $34,666,667. The actual value, at 60% project completion, was $43,466,667. Table 2 shows the details for case study two.

Table 2: Data Regarding Case Study 2.

| Bidders  | Cost       | Result     | Budget of project | Actual value at 60% completion | Percent of cost deviation |
|----------|------------|------------|-------------------|--------------------------------|----------------------------|
| Cont AMG | $24,645,130| Withdrawn  | $35,733,333       | $43,466,667                    | 25.4%                      |
| Cont ATCCSA | $35,422,798 | Withdrawn  |                   |                                |                            |
| Cont SACC | $37,317,248| Selected   |                   |                                |                            |
| Cont BCL  | $39,474,272|            |                   |                                |                            |
| Cont AAU  | $40,678,645|            |                   |                                |                            |
Five vendors bid on case study three. The lowest bid, provided by Cont DMC, was $38,501,294, whereas the highest bid, provided by Cont ACCL, was $45,530,146. The budget for project three was $40,000,000. The project owner selected the contractor with the lowest price, which was Cont DMC at $38,501,294. However, the actual value, at 80% completion, was $41,866,667. The bidding information is shown in Table 3.

**Table 3: Data Regarding Case Study 3.**

| Bidders     | Cost         | Result    | Budget of project | Actual value at 80% completion | Percent of cost deviation |
|-------------|--------------|-----------|-------------------|--------------------------------|--------------------------|
| Cont DMC    | $38,501,294  | Selected  | $40,000,000       | $41,866,667                    | 8.7%                     |
| Cont AAF    | $40,397,923  |           |                   |                                |                          |
| Cont BCL    | $40,883,645  |           |                   |                                |                          |
| Cont ACC    | $41,919,152  |           |                   |                                |                          |
| Cont ACCL   | $45,530,146  |           |                   |                                |                          |

The fourth case study focused on project four in which five contractors applied for the project. The lowest price, provided by Cont AMG, was $27,070,573, whereas the highest price, provided by Cont BCL, was $40,965,773. The budget for the project was $28,000,000. Therefore, Cont AMG won the competition with the lowest price, $27,070,573. However, the actual value of the project at 62% completion totaled $39,200,000. The bidding information is shown in Table 4.

**Table 4: Data Regarding Case Study 4.**

| Bidders     | Cost         | Result    | Budget of project | Actual value at 62% completion | Percent of cost deviation |
|-------------|--------------|-----------|-------------------|--------------------------------|--------------------------|
| Cont AMG    | $27,070,573  | Selected  | $28,000,000       | $39,200,000                    | 44.8%                    |
| Cont ATCCSA | $33,554,292  |           |                   |                                |                          |
| Cont SACC   | $36,304,503  |           |                   |                                |                          |
| Cont AAU    | $40,434,665  |           |                   |                                |                          |
| Cont BCL    | $40,965,773  |           |                   |                                |                          |

*A New University Case Study Analysis*

All the four new university case studies analyzed experienced cost overruns. As mentioned above, all these projects used the low-bid delivery system. In case study one, a contractor, AAAFS, was selected based on its low bid; however, cost overruns of 24% at completion totaled approximately $7,061,123. In case study two, there was approximately $6,149,419 in cost overruns in comparison to the bid price, and $8,800,000 in cost overruns at 60% completion in comparison to the signed contract. In case study three, a contractor, DMC, was selected due to the low bid price; however, this project experienced $3,365,373 in cost overruns. Moreover, the completion rate for that project was 80%. In case study four, a contractor, AMG, was selected due to its low bid price, and cost overruns reached $12,129,427. The percentage of completion in case study four was 62%. Figures 3, 4, 5, and 6 show the selected contractors in comparison to other bidders and cost overruns. The total of cost overruns for these case studies is $31,355,923. This wasted amount is equivalent to the cost of one university building. The low-bid system has been proven to offer substandard performance and cost overruns at the new university campus. Table 5 shows the details regarding cost overruns for the case studies. Although the instruction
of the procurement system does not allow of cost overruns to exceeding 10% of the total value of the contract, however, dividing bids into several parts breaks this rule.

![Figure 3. Selected contractor and cost overruns in case study one.](image1)

![Figure 4. Selected contractor and cost overruns in case study two.](image2)

![Figure 5. Selected contractor and cost overruns in case study three.](image3)

![Figure 6. Selected contractor and cost overruns in case study four.](image4)

| Table 5: Details of Case Study Cost Overruns. |
|---------------------------------------------|
| Contract Value: | $31.6 Million | $34.6 Million | $38.5 Million | $27 Million | $32.9 Million |
| Total Cost of Contracts: | $131.7 Million | | | | |
| Percent overrun: | 22.3% | 25.4% | 8.7% | 44.8% | 23.3% |
| Cost overrun: | $7.1 Million | $8.8 Million | $3.4 Million | $12.1 Million | $7.8 Million |
| Total: | $31.4 Million | | | | |

**Survey**

A project director and five engineers at the new university were interviewed, and they identified seven risk factors that could cause cost overruns in Saudi Arabia. These seven risk factors were change orders, bid proposal errors, contractor’s errors, consultant’s errors, client’s change of scope, dividing bids into several parts, and unforeseen risks. The survey consisted of three parts: Daley causes, cost overruns causes, and the procurement system. The first and third parts used in
other searches. The second part that used in this study was sent to more than 1,500 classified contractors and 14 project departments of universities in Saudi Arabia for rating the seven risk factors that caused cost overruns (see Appendix). The survey was responded to by 761 classified contractors and 43 representatives of universities. Table 6 shows the result of the survey.

Table 6: Survey Result.

| Causes of cost overruns                     | Representatives of universities | Classified contractors |
|--------------------------------------------|--------------------------------|------------------------|
|                                            | Not Common | Don’t Know | Common           | Not Common | Don’t Know | Common           |
| Client’s Change of Scope                   | 4.65%      | 18.60%    | 76.75%           | 6.57%      | 15.90%     | 77.53%           |
| Unforeseen Risks                           | 18.61%     | 30.23%    | 51.16%           | 14.72%     | 34.82%     | 50.46%           |
| Change Orders                              | 0.00%      | 4.65%     | 95.35%           | 5.52%      | 12.88%     | 81.60%           |
| Bid Proposal Errors                        | 13.95%     | 9.30%     | 76.75%           | 8.28%      | 12.88%     | 78.84%           |
| Contractor’s Errors                        | 13.95%     | 34.89%    | 51.16%           | 24.84%     | 38.50%     | 36.66%           |
| Consultant’s Errors                        | 27.91%     | 41.86%    | 30.23%           | 10.12%     | 41.79%     | 48.09%           |
| Dividing Bids into Several Parts           | 18.61%     | 30.23%    | 51.16%           | 14.72%     | 35.74%     | 49.54%           |

Survey Statistical Analysis

Validity

The construct validity was used to assess the validity of the items of the cost overrun causes the project in new Saudi Arabian universities. The Pearson’s correlation was used to evaluate the relationship between each item and the total representing all the items. Generally, a correlation value of 0.70 or higher reflects a strong (high) relationship, and the item is consistent with the total of the items. The results are included in table (7). The formula for calculating $r$ is:

$$ r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2][n\Sigma y^2 - (\Sigma y)^2]}} $$

Where: (n) is the sample size  
(x) is the item values  
(y) is the total of the items

The correlation values shown in table 7 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 (Change Orders) and the cost overrun (0.841). A value of 0.70 or higher is considered to express a strong relationship.

Table 7: The Construct Validity for the Cost Overrun Causes (all sample n=804).

| Item no. | Cost overrun causes             | Over all causes |
|----------|--------------------------------|----------------|
| 1        | Change Orders                   | 0.841          |
| 2        | Bid Proposal Errors             | 0.888          |
| 3        | Contractor’s Errors             | 0.884          |
| 4        | Consultant’s Errors             | 0.911          |
| 5        | Client’s Change of Scope        | 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 are 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 formula for calculating α is:

\[ \alpha = \frac{n}{n-1} \left(1 - \frac{\sum V_i}{V_t}\right) \]  

(Cronbach, 1951, p. 295)

Where: 
- \( n \) is the number of items
- \( V_i \) is the item variance
- \( V_t \) is the variance of the items total

The value of the internal consistency provided in table 8 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).

Table 8: Reliability Analysis Using Cronbach’s Alpha the cost overrun causes (overall sample n=804).

| No. of items | Value  |
|--------------|--------|
| Cost overrun causes | 7      | 0.960  |

Prioritizing causes of cost overruns

The following formulas were used to calculate the included statistical indices:

1. The mean
   Mean (m) = \( \Sigma [a. (n/N)] \)
   Where:
   - \( a \) is the weight being used
   - \( n \) The weight frequency
   - \( N \) is the sample size

2. The standard deviation
   \[ SD = \sqrt{\frac{\sum (x - \bar{x})^2}{N-1}} \]
   Where:
   - \( x \) is the response value
   - \( \bar{x} \) is the mean
   - \( n \) is the sample size

3. Frequency index (F.I.) is the percentage of the mean being assessed out of the highest response weight
   \[ F.I. = \Sigma [a. (n/N)] \times 100/10 \]
   Where:
   - \( a \) is a constant of weighting given to each respond (1=not common, 5=don’t know, 10=common),
   - \( n \) is the frequency of weight
   - \( N \) is the total number of responses for this research
Table 9 reflects the descriptive statistics for the cost overrun causes for new Saudi Arabian university projects from the contractor’s perspective. The results show that item no. 1 (Change Orders) is ranked first as it recorded the greatest FI (88.6), while item no. 3 (Contractor’s Errors) is ranked last as it recorded the lowest FI (58.6). All other values ranged between these two values. It is noted that the top three cost overrun causes had a score above 80.0 FI.

Table 9: Descriptive statistics for the causes of cost overruns according to contractors arranged in descending order (contractor’s sample n=761).

| Cause code | Item                        | Frequency |            |            | mean  | SD   | FI*   | order |
|------------|-----------------------------|-----------|------------|------------|-------|------|-------|-------|
|            |                             | Not common (1) | Don’t know (5) | Common (10) |       |       |       |       |
| 1          | Change Orders               | 5.5       | 12.9       | 81.6       | 8.86  | 2.53 | 88.6  | 1     |
| 2          | Bid Proposal Errors         | 8.3       | 12.9       | 78.8       | 8.61  | 2.83 | 86.1  | 2     |
| 5          | Client’s Change of Scope    | 6.6       | 15.9       | 77.5       | 8.61  | 2.72 | 86.1  | 2     |
| 4          | Consultant’s Errors         | 10.1      | 41.8       | 48.1       | 7.00  | 3.11 | 70.0  | 4     |
| 7          | Unforeseen Risks            | 14.7      | 34.8       | 50.5       | 6.93  | 3.35 | 69.3  | 5     |
| 6          | Dividing Bids into Several Parts | 14.7    | 35.7       | 49.5       | 6.89  | 3.34 | 68.9  | 6     |
| 3          | Contractor’s Errors         | 24.4      | 38.9       | 36.7       | 5.86  | 3.52 | 58.6  | 7     |

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

Table 10 reflects the descriptive statistics for the cost overrun causes for new Saudi Arabian university projects from the perspective of university representatives. The results show that item no. 1 (Change Orders) is ranked first as it recorded the greatest FI (97.7), while item no. 4 (Consultant’s Errors) is ranked last as it recorded the lowest FI (54.0). All other values ranged between these two values. It is noted that the top three cost overrun causes had a score above 80.0 FI.

Table 10: Descriptive statistics for the causes of cost overruns according to representatives of universities arranged in descending order (university representatives n=43).

| Cause code | Item                        | Frequency |            |            | mean  | SD   | FI*   | order |
|------------|-----------------------------|-----------|------------|------------|-------|------|-------|-------|
|            |                             | Not common (1) | Don’t know (5) | Common (10) |       |       |       |       |
| 1          | Change Orders               | 0.0       | 4.7        | 95.3       | 9.77  | 1.07 | 97.7  | 1     |
| 5          | Client’s Change of Scope    | 4.7       | 18.6       | 76.7       | 8.65  | 2.60 | 86.5  | 2     |
| 2          | Bid Proposal Errors         | 14.0      | 9.3        | 76.7       | 8.28  | 3.30 | 82.8  | 3     |
| 3          | Contractor’s Errors         | 14.0      | 34.9       | 51.2       | 7.00  | 3.36 | 70.0  | 4     |
| 6          | Dividing Bids into Several Parts | 18.6    | 30.2       | 51.2       | 6.81  | 3.57 | 68.1  | 5     |
| 7          | Unforeseen Risks            | 18.6      | 30.2       | 51.2       | 6.81  | 3.57 | 68.1  | 6     |
| 4          | Consultant’s Errors         | 27.9      | 41.9       | 30.2       | 5.40  | 3.49 | 54.0  | 7     |

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

Table 11 reflects the descriptive statistics for the cost overrun causes for new Saudi Arabian university projects from both the perspectives of the contractors and university representatives. The results show that item no. 1 (Change 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 11: Descriptive statistics for the causes of cost overruns according to both perspectives of contractors and university representatives (n=761).

| Cause code | Item                        | Frequency |            |            | mean  | SD   | FI*   | order |
|------------|-----------------------------|-----------|------------|------------|-------|------|-------|-------|
|            |                             | Not common (1) | Don’t know (5) | Common (10) |       |       |       |       |
| 1          | Change Orders               | 5.5       | 12.9       | 81.6       | 8.86  | 2.53 | 88.6  | 1     |
| 2          | Bid Proposal Errors         | 8.3       | 12.9       | 78.8       | 8.61  | 2.83 | 86.1  | 2     |
| 5          | Client’s Change of Scope    | 6.6       | 15.9       | 77.5       | 8.61  | 2.72 | 86.1  | 2     |
| 4          | Consultant’s Errors         | 10.1      | 41.8       | 48.1       | 7.00  | 3.11 | 70.0  | 4     |
| 7          | Unforeseen Risks            | 14.7      | 34.8       | 50.5       | 6.93  | 3.35 | 69.3  | 5     |
| 6          | Dividing Bids into Several Parts | 14.7    | 35.7       | 49.5       | 6.89  | 3.34 | 68.9  | 6     |
| 3          | Contractor’s Errors         | 24.4      | 38.9       | 36.7       | 5.86  | 3.52 | 58.6  | 7     |

(*) mean percentage out of the maximum weight (10)
Table 11: Descriptive statistics for the causes of cost overruns according to contractors and representatives of universities arranged in descending order (contractors and university representatives n=804)

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

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

Best Value Case Studies

In 1991, the Best Value Approach (BVA) was instituted by Dr. 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 the principles of BVA, through which decision-making, management, and control can be minimized. Project performance is affected when projects apply value to, or are based on, price. The industry structure model shows that projects obtain high levels of performance when value based, and experienced substandard performance when piece based, as shown in Figure 1. 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 work 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).

![Figure 1. Industry structure model (Kashiwagi, 2014).](image-url)
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. The selection filters are project capability, interview, prioritize (identify best value), and dominance check for an appropriate vendor (see Figure 2). The third phase is clarification, which is 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 execution phase, the final phase of PIPS, 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, risk management plan, and performance measurements.

![Figure 2. Shown selection phase filters (Kashiwagi, 2014).](image)

The PIPS process has proven successful when applied. Table 12 shows case studies that have applied PIPS. These case studies show that 100% of the projects that utilized PIPS finished within their budget. 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. PIPS consider both cost and performance when selecting a contractor rather than price only (CFMA’s, 2006; Chan, 2004; Egan, 1998; PBSRG, 2010; Kashiwagi, 2010, 2011).

**Table 12: Examples of PIPS 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).
Best Value Case Studies Analysis

BVA and PIPS showed a high level of construction performance in PIPS case studies. Of the cases studied, 100% stayed within budget, and there were no changes in orders. BVA and PIPS used many phases and filters to find expert contractors with high levels of performance. In addition, projects in which PIPS was applied recorded extremely high percentages of on-time delivery and high satisfaction levels. When contractors were chosen, the clarification phase identified everything within the contractor’s scope and plan from the beginning to the end. Moreover, during the execution phase, PIPS provided many tools to increase project performance through applied risk management and performance measurement. In contrast, the low-bid method depended on price alone when awarding projects. Then, during the execution stage, projects exhibited low performance, delay issues, and cost overruns. As mentioned in the literature review, contractors who won projects according to the low-bid method provided very low prices to win contracts only to later change project orders to increase profit. These situations lead to cost overruns.

The low-bid strategy considers the price criterion alone; however, the selection phase of PIPS considers both performance and price. Consequently, PIPS locates expert contractors with high performance and low prices. Also, it prevents cost overruns through four phases. According to Kashiwagi (2011), the most important phase is clarification. During this phase, a selected contractor should make a risk management plan (RMP) that includes all risks related to the contractor and owner. Also, the contractor should provide a milestone schedule. Moreover, the parties should negotiate technical requirements and the method of delivery. In the execution phase, the contractor should submit WRR and DR. Consequently, projects utilizing PIPS have demonstrated 100% delivery of projects within budget and on time.

Conclusion

The low-bid method and its results lead to significant costs for the Saudi Arabian government because the lowest bids do not reflect the actual price of projects. This study analyzed four previous case studies that were built on a university campus, each of which contained complete project information. In case study one, the cost overruns totaled approximately $7,061,123, with 22.3% cost deviation. In case study two, the cost overruns were approximately $8,800,000, with 25.4% cost deviation. Case study three experienced approximately $3,365,373 in cost overruns, with 8.7% cost deviation. In case study four, the cost overruns reached approximately $12,129,427, with 44.8% cost deviation. The total cost overruns for these case studies totaled approximately $31,355,923. This occurred in just four projects, showing what occurs when contracts are awarded to contractors based on price alone. Paradoxically, when the government wishes to save money by awarding projects to the lowest bidders, these projects end up costing a significant and unexpected amount of money and experience numerous delays.

Interviews with a project director and five engineers at the university case study identified seven risk factors that could cause cost overruns in Saudi Arabia. After the survey was conducted, the 761 classified contractors and 43 universities’ representatives rated seven risk factors. The overall result showed that “change orders” was ranked first with a recorded FI of (89.1). The
classified contractors rated this factor with a FI of (88.6) and the universities’ representatives rated this with a FI of (97.7). “Client’s change of scope” was ranked second with a recorded FI of (86.2). The classified contractors rated this with a FI of (86.1) and universities’ representatives gave it a FI of (86.5). The third factor was “bid proposal errors,” which comprised an overall FI of (85.9). The classified contractors rated this with a FI of (86.1) and the universities’ representatives with a FI of (82.8). “Unforeseen risks” was ranked fourth among risk factors. Overall, it received a FI of (69.3). The classified contractors rated this with a FI of (69.3), and universities’ representatives ranked it with a FI of (68.1). “Consultant’s errors” was ranked fifth; overall it received a FI of (69.1). The classified contractors rated this with a FI of (70.0), and universities’ representatives rated it with a FI of (54.4). The cause of cost overruns that the sample group ranked sixth was the issue of “dividing bids into several parts,” which received an overall FI of (68.8). The classified contractors rated this with a FI of (68.9) and universities’ representatives rated it with a FI of (68.1). The last factor is “contractors’ errors,” which received a FI reading of (59.2). The classified contractors rated this with a FI of (58.6) and universities’ representatives rated it with a FI of (70.0).

Thus, “changed orders,” “client’s change of scope,” and “bid proposal errors” are the most significant causes of cost overruns in Saudi Arabia. Conversely, BVA and PIPS display a high level of construction performance—100% of such projects stay within budget and are completed on time with 0% changed orders. PIPS has demonstrated the ability to locate expert contractors with the highest performance levels and the lowest price. During the clarification phase, expert contractors will clarify and consider all risks that could happen during the execution phase and cause cost deviation. Therefore, PIPS can save project budgets from waste by using multiple phases and filters to award projects to expert contractors. This study recommends an adjustment of the current procurement model so that in the future, Saudi Arabia runs projects using the BV and PIPS systems instead.
# Appendix

## Survey

**Part 1 Instructions:** Please rate project delay causes in Saudi Arabian universities, with 1 meaning “not common,” 5 meaning “don’t know,” and 10 meaning “common.” Please only use one of these three choices for each question.

| Criteria                                                                 | Rating (1, 5, or 10) |
|--------------------------------------------------------------------------|----------------------|
| Bidding System (Low Price)                                               |                      |
| Poor Contractor Performance                                              |                      |
| Lack of Experienced Contractors                                          |                      |
| Manpower Shortage                                                        |                      |
| Inadequate Contractor Qualifications                                     |                      |
| Material Delivery                                                        |                      |
| Owner’s Late Design Document Review and Approval                         |                      |
| Delay in Progress Payments to Contractors                                |                      |
| Lack of Consultancy Employees                                            |                      |
| Lack of Vision                                                           |                      |
| Design Requirements Do Not Reflect Reality                               |                      |
| Owner Controlled Designer                                                |                      |
| Lack of Project Budget                                                   |                      |
| Owner’s Wrong Decision Making                                            |                      |
| Owner Did Not Follow Solidarity Conditions                               |                      |
| Inadequate Project Management Department                                 |                      |
| Changing Consultant During Implementation                                |                      |
| Conflict among Company Partners                                          |                      |
| Contractor Did Not Study Proposal                                        |                      |
| Contractor Lacked Project Management Skills                              |                      |
| Contractor Ability                                                       |                      |
| Concurrent Projects                                                      |                      |
| Delayed Payment to Laborers                                              |                      |
| Poor Consultant Performance                                              |                      |
| Consultant Delayed Project to Extend His or Her Contract with Owner      |                      |
| Unclear Procurement System                                               |                      |
| New Worker Regulations                                                   |                      |

**Part 2 Instructions:** Please rate the causes of cost overruns to projects in Saudi Arabian universities, with 1 meaning “not common,” 5 meaning “don’t know,” and 10 meaning “common.” Please only use one of these three choices for each question.

| Criteria                                                                 | Rating (1-5 or 10) |
|--------------------------------------------------------------------------|-------------------|
| Client’s Change of Scope                                                 |                   |
| Unforeseen risks                                                         |                   |
| Change Orders                                                            |                   |
| Bid Proposal Errors                                                      |                   |
| Contractor’s Errors                                                      |                   |
| Consultant’s Errors                                                     |                   |
| Dividing Bids into Several Parts                                         |                   |
**Part 3 Instructions:** please fill in the survey below by providing a rating per question. 1 means you “disagree,” 5 means you “don’t know,” and 10 means you “agree.” Please only use one of these three choices for each question.

| No. | Questions                                                                                                                                                | Rating (1-5 or 10) |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
|     | **Current Procurement System**                                                                                                                                                                           |
| 1   | I have high satisfaction with the current procurement system                                                                                  |                    |
| 2   | Do you think selecting contractors solely based on price is the optimal practice for procuring services?                                         |                    |
|     | **Best Value Principles**                                                                                                                                  |                    |
| 1   | Do you think selecting contractors based on performance with price would be better?                                                                  |                    |
| 2   | Would you support improvements to the current procurement system that selects contractors based on performance with price?                         |                    |
| 3   | I would you be interested in learning more about a new procurement model that may improve the current procurement system by identifying and utilizing expertise. |                    |
|     | **New Proposed Procurement System Improvements**                                                                                                       |                    |
| 1   | In addition to evaluating price, would requiring contractors to submit verifiable performance information improve the procurement process?                 |                    |
| 2   | In addition to evaluating price, would requiring contractors to submit potential risks they foresee on the project and how they will mitigate and manage them improve the procurement process? |                    |
| 3   | In addition to evaluating price, would requiring contractors to propose ways they can add value to a project in their proposal improve the procurement process? |                    |
| 4   | During the clarification period, would interviewing the selected contractor’s project manager performing the work improve the procurement process?       |                    |
| 5   | During the clarification period, would requiring the selected contractor to provide a project plan from beginning to end, including scope of work, technical and milestone schedule, major risks that fall outside of that scope before they receive a contract, and how they will measure their performance, improve the procurement process? |                    |
| 6   | During the execution of a project, would project performance increase if contractors measured their performance (time, cost, quality) weekly and submitted to clients? |                    |
| 7   | Would it be beneficial if the government documented all performance on projects and posted the performance for all contractors to compare?                |                    |
| 8   | Would these new procurement processes improvements help to identify expertise and use it to improve overall performance on projects?                     |                    |

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