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Letter from the Editor **December 2017**

Fellow researchers and industry visionaries:

Happy holidays! We are in an exciting time for academic research. We find ourselves in an environment of change, an environment where the academic researchers and industry are still disjointed, where the research is still not having an impact on the industry practices. We find the industry is still leading the researchers. We find journal papers so complex, that no one in the industry can utilize the research findings. Researchers are placing far more importance on methodology than the research results. It is becoming an environment where the researchers are the "Emperors with No Clothes." We truly are in silos.

Academic research papers have become a way for academics to receive government grants, get promoted and get into administrative positions where they no longer have to do research. University management has created a system of rated journals where putting research papers into highly rated journals means more and makes the research more significant regardless of content or value to the industry.

I have been in academic research for 25 years. My performance metrics include:

25 years of research	$17.6M in Research Funding
2,000+ Research Tests Conducted	
$6.6B of Services Delivered	90% Customer Satisfaction
33 states in the USA	7 different Countries
1,000+ Professional Presentations	
350 Refereed Journals, Conference Papers and Books.	
54 Intellectual Property (IP) Licenses issued by Arizona State University. [Most licensed technology at the most innovative university in the U.S. (U.S. News and World Report)].	

I am the creator of the Best Value Approach (BVA), which includes the Information Measurement Theory (IMT), Industry Structure Model, the Performance Information Procurement System (PIPS) and the Performance Information Risk Management System (PIRMS).

I recently retired [separated from Arizona State University] and am doing some of my most innovative research work. We appreciate the CIB for allowing a platform for innovation to flourish. We also appreciate the International Facility Management Association (IFMA), of which I am a Fellow, which has allowed many of our research tests to be done at IFMA facilities. The future in research will be to do innovative work, for researchers to lead and help the industry, and for research to be dominant enough to add tremendous value. To be implementable in industry, research results must be simple and not complex. The research results must be clear

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and minimize the need for industry readers to be a genius in math and statistics to understand the research results. It must be like the technology of automation, robotics and information systems. If it is simple and works, it will be utilized. If it is complex, it will not be used. We encourage young researchers to participate in innovation that can be implemented in the industry. The results must be published quickly and utilized by the industry. Researchers must have courage and help change the industry. I highly encourage researchers to create new paths and not to follow the existing paths, which have not led to any innovation.

Happy holidays to all!

Dr. Dean

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Vietnam Construction Industry Performance Issues and Potential Solutions

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This paper provides a literature review assessing the performance and issues of delivering construction services in the Vietnam Construction Industry (VCI). The research also explores a potential solution that could improve the performance of the VCI. The results show multiple non-performance issues that the VCI has experienced in the past 15 years, and presents a comparison between these issues and issues from other countries. The results reveal that the top 5 non-performance issues in the VCI include poor design services, frequent design changes, lack of skilled contractors, a lack of experienced project managers, and financial difficulties of owners. The comparison identifies that 87% of VCI issues were also experienced in other countries. Since the VCI has similar issues as other countries, the author proposes that the VCI can improve construction performance by implementing successful methodologies from other countries. This paper investigates the Best Value Performance Information Procurement System (BV PIPS) as a potential solution because of two key aspects: (1) sufficient documentation of on time, on budget, and high customer satisfaction from this model, and (2) sufficient testing from other regions and countries to show similar improvement in construction performance.

Keywords: Vietnam, Construction, Performance, Best Value, PIPS.

The Vietnam Construction Industry

Once regarded as an economic disaster, Vietnam is now emerging as the latest East Asian growth engine, which attracts the attention of global investors. Today, Vietnam is currently among the countries with the highest gross domestic product (GDP) growth rates. In 2002, GDP growth in Vietnam hit 7% (high) and recorded the fastest economic growth in Southeast Asia. In 2007, the GDP kept growing to 8.5%, marking the third consecutive year above the 8% benchmark for this small country (Ling & Bui, 2010; Long *et al.*, 2004). That was an all-time high record in terms of growth rate, placing Vietnam second only to China in the Asia region. In 2009, Vietnam was one of the only South East Asian emerging economies not to have gone into a recession during the 2008 U.S. financial crisis. Nonetheless, it had been affected deeply by the crisis as shown in Figure 1 (“Vietnam GDP Growth Rate”, 2017). Since 2013, GDP growth has been recovering and increasing above 6% on average until now. In comparison, the U.S. GDP growth has been 3.2% on average in the past 10 years (Figure 2, “U.S. GDP Growth Rate”, 2017).

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Figure 1: Vietnam GDP Growth Rate 2001 – 2016.

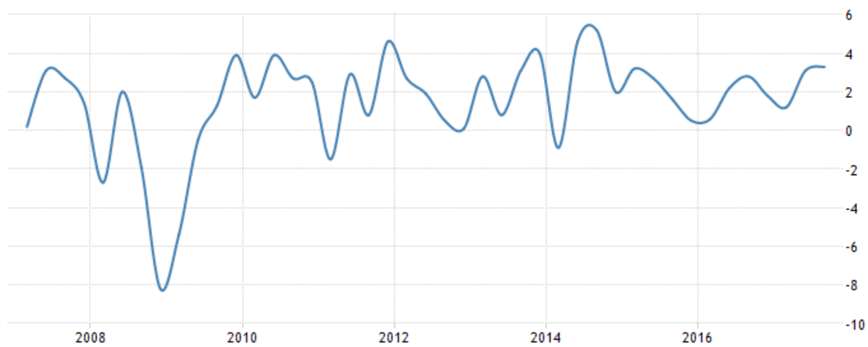

Figure 2: U.S. GDP Growth Rate 2008 – 2016.

The construction sectors account for significant economic growth in Vietnam. The Vietnam Construction Industry (VCI) has been growing at 15% annually in the past 10 years. In 2002, VCI comprised 39% of the GDP growth rate. In 2011, VCI increased its contribution to 41.1%. Thanks to the promotion of industrialization from the Vietnamese government and infusing of foreign investments through the Official Development Assistance (ODA) program, construction growth rate has been healthy and consistent over the years (Nguyen Duy *et al.*, 2004; Khanh & Kim, 2014; Luu *et al.*, 2008). However, despite large growth and increasing demand for construction, multiple research efforts in the past 15 years had identified that VCI performance still left a lot to be desired.

Literature Review

It is widely accepted that a project is successful when it is finished on time, within budget, and to stakeholders' satisfaction (Long *et al.*, 2004). A literature research has been conducted to evaluate VCI performance in terms of time, cost, and customers' satisfaction.

Time and Cost Performance

Many Vietnam construction projects have faced various problems that have caused significant scheduling delays. In 2009, a research examined 77 projects completed from 1999 to 2005. These projects were in the southeastern area, within cities and provinces where the demand and concentration of building projects were large. It was identified that 75% of those projects were delayed, and 66% of them were over budget (Hoai Xuan, 2016; Luu *et al.*, 2009). In 2009, another study identified that Vietnam projects suffered from over 10% time-overrun of the original construction duration (Le-hoai *et al.*, 2009). In 2012, the Vietnam Federation of Civil Engineering Associations estimated that 99% of investment projects in Vietnam were delayed (Anh Duc, 2012).

Stakeholder Satisfaction

Disputes between parties are signs of non-satisfactory performance. In 2004, a study identified that disputes between construction participants was one of the top causes of project failure in Vietnam (Long *et al.*, 2004). In 2007, another study claimed that conflicts between project owners and government agencies negatively influenced many projects (Thuyet *et al.*, 2007). In 2008, Vietnamese government organizations also acknowledged their dissatisfaction with construction delay and cost overrun problems, especially with government-related funded projects (Le-Hoai *et al.*, 2008). This dissatisfaction was found to be based on empirical evidence showing that public projects in Vietnam usually took longer to complete compared to their private counterparts. This was also consistent with observations in Hong Kong, UK, and Malaysia (Luu *et al.*, 2009). Also in 2008, many problems arose during the implementation of multiple construction projects that caused many citizens to lose faith in the government's ability to deliver public projects (Le-Hoai *et al.*, 2008).

Knowledge Gaps

The literature review revealed that there are no studies that identify common causes of non-performance in Vietnam. Such studies are critical since they may help the VCI learn from other countries to identify practices that lead to better performance of VCI projects.

Research Method

This study provides a major literature research and review. The objectives of this study are three-fold: (1) identify poor performance causes of the VCI, (2) identify similarities between poor performance causes of the VCI and the rest of the world, and (3) identify practices that could help resolve those similar causes from other regional and national studies.

In order to achieve the aforementioned objectives, the author conducted the following steps:

1. The author conducted a major review of VCI publications, surveys, and interviews in the past 15 years to identify the root causes of poor performance and prioritized them by appearance frequency.
2. The author then conducted a literature research on publications from other countries to identify non-performance causes that they have in common with the VCI and created a list of prioritized common issues (Figure 2).

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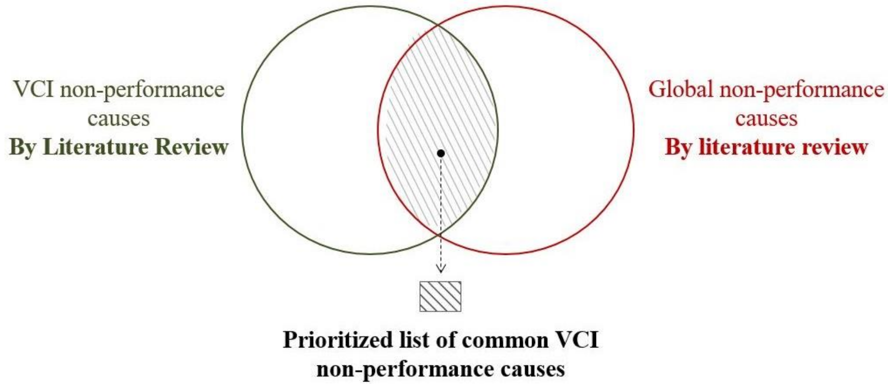

Figure 3: Compilation of the list of common VCI non-performance causes

3. The author identified practices and theories from other countries that have been developed to help improve construction performance. The author selected one of these solutions to improve the VCI performance.

Causes of Non-Performance

Many VCI research efforts over the last 15 years have documented poor performance by conducting industry surveys. The author reviewed this research to compile all non-performance causes from past studies. The results are shown in Table 1.

Table 1: Sample analysis of data table explicitness.

#	Causes of failure of construction projects	Nguyen Duy *et al.*, 2004	Thuyet *et al.*, 2007	Le-Hoai *et al.*, 2008	Luu *et al.*, 2008a	Luu *et al.*, 2008b	Yean *et al.*, 2009	Le_Hoai *et al.*, 2009	Ling & Bui, 2010	Ling & Hoang, 2010	Nguyen *et al.*, 2013	Le *et al.*, 2013	Occurrences	Agreed Frequency	Ranking
1	Ineffective designs and frequent design changes		x	x	x	x	x		x		x	x	8	73%	1
2	Poor contractor performance	x		x	x	x	x	x			x		7	64%	2
3	Ineffective project management	x	x		x	x		x			x	x	7	64%	2
4	Financial difficulties of owner			x		x	x	x	x		x	x	7	64%	2
5	Financial difficulties of contractor	x		x		x	x	x	x				6	55%	5
6	Poor site management and supervision	x	x	x		x			x		x		6	55%	5
7	Corruption/Collusion	x			x		x			x	x		5	45%	7
8	Lack of experience in complex projects		x			x	x		x		x		5	45%	7
9	Slow payment of completed works			x	x	x			x				4	36%	9
10	Bureaucratic administrative system	x	x		x					x			4	36%	9
11	Lack of accurate historical information	x	x	x					x				4	36%	9
12	Interest and inflation rates			x		x				x			3	27%	12

#	*Causes of failure of construction projects (continued)*	*Nguyen Duy et al., 2004*	*Thuyet et al., 2007*	*Le-Hoai et al., 2008*	*Luu et al., 2008a*	*Luu et al., 2008b*	*Yean et al., 2009*	*Le_Hoai et al., 2009*	*Ling & Bui, 2010*	*Ling & Hoang, 2010*	*Nguyen et al., 2013*	*Le et al., 2013*	*Occurrences*	*Agreed Frequency*	*Ranking*
13	Unpredictable government policies and priorities			x					x	x			3	27%	12
14	Poor subcontractor performance			x					x			x	3	27%	12
15	Slow site handover	x				x		x					3	27%	12
16	Defective works and reworks			x		x		x					3	27%	12
17	Lack of capable owners	x	x			x							3	27%	12
18	Improper planning and scheduling	x	x								x		3	27%	12
19	Inaccurate estimates	x		x								x	3	27%	12
20	Poor tendering practices (Low bid practice)	x	x					x					3	27%	12
21	Inadequate legal framework						x			x			2	18%	21
22	Owners' site clearance difficulties	x				x							2	18%	21
23	Shortages of materials			x				x					2	18%	21

The results are consistent with findings of studies from other geographical regions (Elawi, 2015; Rivera, 2016a; Algahtany, 2017). Most of the problems listed above are a result of human and management error, as opposed to technical limitations (materials, equipment, environmental, etc.) (Algahtany, 2017; Almutairi, 2017). In the case of Vietnam, consultants, contractors, and coordination had caused the most amount of risks while clients/owners caused the most severe risks to projects. It has been estimated elsewhere that 20-40% of capital investment in construction was lost due to poor management for which bureaucracy and briberies were mainly responsible for (Long *et al.*, 2004). The national construction companies rarely paid attention to productivity or time and cost performance of their projects. Because of the lack of competition and hard dependence on production norm, the estimation was not strict. This is the replication of Soviet regime (Luu *et al.*, 2009).

Bidding methods are also being questioned. Several studies and interviews identified that poor bidding practices led to hiring ineffective contractors and consultants. Contracts were awarded primarily based on price and rapport of the bidders without consideration of their actual performance. Often, the lowest bidders were chosen to save on project cost. Since tendering is a very sensitive issue, accepting the lowest-price tender was a quick and "safe" way to help the public owners defend themselves from criticisms and to show accountability. Nevertheless, in some cases, bidders submitted the lowest price in order to win the bid and at the later stage, they would negotiate with the owner for change orders to increase their offer. Another problem with bidding in the VCI was unethical behavior and collusion of bidders. Collusive tendering occurred when a number of firms agreed between themselves either not to bid, or to bid in such a manner as not to be too competitive with each other. Incompetent contractors had been awarded contracts with arrangements in the past and they could not finish projects on time and satisfy quality expectations (Thuyet *et al.*, 2007).

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Comparing VCI Issues to Other Construction Industries

Other studies from different countries identified that project stakeholders in developing countries face similar problems in spite of different geographic, economic, political and social backgrounds. In the case of Vietnam, 91% (21/23) of issues that VCI had been facing occurred in other countries as well. Table 2 summarizes shared issues between Vietnam and other countries.

Table 2: Shared Issues between VCI and other Construction Industries.

#	Vietnam Causes of failure of construction projects	Kuwait (Koushki, 2005)	South Korea (Acharya *et al.*, 2006)	Hong Kong (Lo, 2006)	UAE (Faridi, 2006)	Malaysia (Sambasivan, 2007)	Jordan (Sweis, 2007)	Ghana (Frimpong, 2003)	Nigeria (Aibinu, 2006)	UK (Yakubu & Sun, 2010)	Thailand (Toor & Ogunlana, 2008)	Shared Issues?
1	Ineffective designs and frequent design changes	x	x			x	x		x	x	x	Y
2	Poor contractor performance			x		x	x				x	Y
3	Ineffective project management						x		x			Y
4	Financial difficulties of owner	x				x		x	x			Y
5	Financial difficulties of contractor	x		x		x	x	x	x		x	Y
6	Poor site management and supervision				x	x					x	Y
7	Corruption/Collusion											Y
8	Lack of experience in complex projects									x	x	Y
9	Slow payment of completed works							x				Y
10	Bureaucratic administrative system		x		x							Y
11	Lack of accurate historical information											N
12	Interest and inflation rates							x				Y
13	Unpredictable government policies and priorities		x									Y
14	Poor subcontractor performance						x		x	x	x	Y
15	Slow site handover		x									Y
16	Defective works and reworks								x			Y
17	Lack of capable owners	x			x			x				Y
18	Improper planning and scheduling				x	x	x				x	Y
19	Inaccurate estimates		x							x		Y
20	Poor tendering practices (Low bid practice)			x								Y
21	Inadequate legal framework											N
22	Owners' site clearance difficulties										x	Y
23	Shortages of materials	x			x			x				Y

In 2004, Nguyen *et al.* claimed that Vietnam, similarly to other countries, did not have adequately trained professionals in project management. Managerial skills were not being fully utilized in the industry. Hence, it is imperative that project management should be improved in the VCI, and there is now a demand for Vietnam to adopt a procurement and project management model with proven performance from other countries to address the current non-performance issues.

Requirements of the New Project Delivery Model

In addition to studies that identified non-performance factors, VCI researchers have also recommended multiple critical factors that the new project delivery model needed to satisfy to improve the VCI performance. Table 3 is a list of all mentioned factors.

Table 3: Required functions of the new VCI project delivery model.

Code	Improvement Practices & Theories	Suggested Studies
	A. Improvement of the current bidding system	
A1	Contractor selection stage must receive more serious consideration	Le-Hoai *et al.*, 2008; Koushki, 2005; Toor & Ogunlana, 2008
A2	Promote pre-qualification of tenders and selective bidding	Nguyen *et al.*, 2004
A3	The tender selection philosophy that only "lowest-price wins" need to change. The most responsive contractor based on preset criteria should be selected	Thuyet *et al.*, 2007; Lo, 2006; Sambasivan, 2007
A4	Testing contractors' experience and competency through successful projects in the past should have bigger weight in score-scale of contractor selection	Le-Hoai *et al.*, 2008; Sambasivan, 2007; Aibinu, 2006
A5	Designer selection should be based on experience and past performance	Thuyet *et al.*, 2007; Olawale & Sun, 2010
A6	Simplify the bidding process	Thuyet *et al.*, 2007
A7	Save time and cost during the bidding process	Nguyen *et al.*, 2004
A8	Improve contracts to equitably allocate risks between parties	Le-Hoai *et al.*, 2008; Faridi, 2006; Sambasivan, 2007
	B. Performance Tracking	
B1	Measure performance of construction projects despite differences in design specification, delivery methods, administration, and participants	Khanh *et al.*, 2014; Frimpong, 2003
B2	Create practical models to assess the changes of schedule and cost	Le-Hoai *et al.*, 2008; Lo, 2006; Olawale & Sun, 2010; Toor & Ogunlana, 2008
B3	Measure performance for construction companies to find out what should be improved	Luu & Huynh, 2008b; Lo, 2006
	C. Improvement of project management techniques	
C1	Introduce effective construction management at corporate, process, project, and activity levels	Nguyen *et al.*, 2004; Acharya *et al.*, 2006; Lo, 2006; Faridi, 2006; Frimpong, 2003; Olawale & Sun, 2010
C2	Ensure all project parties, especially contractors or subcontractors, should clearly understand their responsibility	Khanh *et al.*, 2014; Koushki, 2005; Acharya *et al.*, 2006; Lo, 2006; Faridi, 2006; Olawale & Sun, 2010; Sambasivan, 2007; Toor & Ogunlana, 2008
C3	Project team members need to be well matched to particular projects	Thuyet *et al.*, 2007
C4	Adequate resources investment in the pre-construction phase	Acharya *et al.*, 2006; Lo, 2006; Sambasivan, 2007

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D. Address high impact issues		
D1	Owners' incapability to plan, organize, motivate, direct, and control projects	Thuyet *et al.*, 2007
D2	More effective communication between owners and designers	Thuyet *et al.*, 2007
D3	Select high performing consultants to evaluate design works	Thuyet *et al.*, 2007; Koushki, 2005; Acharya *et al.*, 2006
D4	Ensure that owners understand their responsibility for monthly timely payment to contractors	Le-Hoai *et al.*, 2009; Sambasivan, 2007
D5	Ensure that all project parties, especially contractors, understand their responsibility to provide materials on time and be well-prepared for this financial responsibility	Le-Hoai *et al.*, 2009; Sambasivan, 2007; Olawale & Sun, 2010
D6	Create and maintain good relationships between both central and local governments	Thuyet *et al.*, 2007
D7	Ensure that projects are inspected by government officials	Ling & Bui, 2010; Faridi, 2006
D8	Ensure foreign experts are involved	Ling & Bui, 2010

CotecCons, Vietnam's top contractor that specializes in both designing and construction has achieved high performance and success by following the principles suggested in Table 3. According to CotecCons' Chairman and General Director, Duong Ba Nguyen, CotecCons measured and justified its own performance to minimize the need to blindly trust the owners' perspective. Nguyen also identified that being prompt with payments was his competitive advantage, in addition to aligning his team members to the right projects and creating a transparent working environment. By applying correct principles, CotecCons has seen success and has become the most reputable contractor in Vietnam. CotecCons' clients include top real estate companies such as Vingroup, Tan Hoang Minh, and Phat Dat. Their past large projects (>$100M value) include GoldMark City, TimesCity Parkhill, Vinhomes Central Park, and the iconic highest skyscraper in Vietnam, Landmark 81. In 2016, CotecCons' revenue and profit were reported at $880M and $75M respectively while Hoa Binh Construction's (second reputable contractor) revenue and profit were $477M and $25M respectively (Mai Linh, 2017; Thanh Tu, 2017).

It has been identified that a project delivery model that could satisfy all requirements in Table 3 does not exist in the VCI. Hence, the need to conduct research to identify a model that matches the requirements to improve the VCI arose.

Potential Solutions for VCI

In a literature search for potential solutions, to resolve the low performance in the delivery of services, the author identified three landmark studies.

First Study – Global Performance Measurement

A study was commissioned by the CIB, Task Group 61 (TG61), which performed a worldwide investigation in 2008 that identified innovative construction methods with documented high-performance results. The study filtered through more than 15 million articles and reviewed 4,500 of them. In the end, the study found only 16 articles with documented performance results. The Best Value (BV) Performance Information Procurement System (PIPS) was one of three

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construction methods found in those articles, and it was found in 75% (12 of 16) of the articles (Egbu *et al.*, 2008).

The other two methods were the Performance Assessment Scoring System (PASS) and the City of Fort Worth Equipment Services Department (ESD - FT). After further investigation, it was found that although the PASS had measured performance information, the system did not document any improvements in performance of their projects. The ESD - FT had measurements to show improvements of their projects, however, this system did not have documented information for how the process worked. It was also a process that was internal to the organization and did not involve projects with suppliers or other organizations (Rivera, 2014).

Second Study – Performance Validation

The Performance Based Studies Research Group (PBSRG) out of Arizona State University commissioned this study, to conduct a follow on worldwide study to the CIB worldwide study in 2008 by Task Group 61 (TG61). The study's objective was to identify all research efforts and systems around the world that are similar to the BV PIPS, as well as construction performance. The study shifted through hundreds of papers, websites, and personal industry contacts, and found similar results as the first study. In this case, BV PIPS was the only method with documented performance results (Rivera, 2014; PBSRG, 2016).

Third Study – Delivery System Comparison

This study was performed in 2013 by a graduate researcher who was interested in identifying the difference between delivery systems. The study reviewed 780 publications in five major databases (EI Compendex, Emerald Journals, ABI/Inform, Google Scholar, and ASCE Library). From the 780 publications reviewed, 103 delivery systems were analyzed and compared. Additionally, 10 company management models were assessed. The top 22 major buyer/supplier theories were identified including: Lean Construction, Supply Chain Management, Total Quality Management (TQM), Just in Time (JIT), Project Management Body of Knowledge (PMBOK), and Conflict Management. After comparing the 133 different delivery approaches, the study found that the Best Value (BV) Performance Information Procurement System (PIPS), was the only model that did not use management, direction, and control to improve performance of the delivery of services, and had documentation showing increased project performance (Kashiwagi, 2013).

BV PIPS was the only process that had sufficient documentation showing that it could improve customer satisfaction and value on projects in the construction industry that involved suppliers.

BV PIPS Introduction

BV PIPS is a revolutionary approach to improving the delivery of services. The system was first conceived in 1991 as part of a Ph.D. candidate's dissertation, where he used the Information Measurement Theory (IMT) as the theoretical foundation to identify the construction industry structure and the cause of poor performance (Kashiwagi, 1991; Kashiwagi, 2017). IMT proposes the use of natural laws and logic to explain reality to identify expertise and value. IMT helped create the Industry Structure (IS) model which proposes that the buyer, or end user (people

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factor), may be the major source of project cost and time deviation. Initially used strictly as a procurement model to select roofing systems and contractors for private organizations (including Intel, IBM, and McDonald Douglas), BV PIPS has since been heavily documented and has spread to be tested in the entire supply chain (construction and non-construction services). Its methodology has been researched and developed, in support of professional groups like the International Council for Research and Innovations in Building and Construction CIB and the International Facility Management Association for the last 25 years, and has been identified as a more efficient approach to the delivery of professional services (Rivera, 2017). Some of the impacts of the BV PIPS are as follows:

1. BV PIPS is the most licensed university developed technology at Arizona State University or any other project / risk management research group with 55 licenses issued by the innovation group AZTech at Arizona State University. Arizona State University had been identified as the most innovative U.S. university in 2016 and 2017, ahead of schools such as Stanford (#2) and M.I.T. (#3) ("Arizona State University," 2017).
2. BV PIPS tests have been tested in 32 states in the U.S. and 10 different countries besides the U.S. (Finland, Botswana, Netherlands, Canada, Malaysia, India, Poland, Brazil, Saudi Arabia, and Norway).
3. Documented performance of over 1,900 projects valued at $6.6 billion, customer satisfaction of 9.8 (out of 10), 93.5% of projects on time and 96.7% on budget (Rivera, 2016b; Rivera, 2016c).
4. Arizona State University business services and procurement department tested the PIPS system and generated $100 million in revenue based on the method in the first three tests, and currently receives $110 million a year from using the method.
5. Research tests show that in procuring of services outside of construction, the observed value is 33% of increase of revenue or decrease in cost of 33% (Kashiwagi, 2013).
6. Minimization up to 90% of client's risk management efforts and transactions due to reduced risk levels and the transfer of risk management and accountability to the vendors (Kashiwagi *et al*, 2012; Kashiwagi *et al*, 2014).
7. The results of PIPS testing has won numerous awards: 2012 Dutch Sourcing Award, the Construction Owners of America Association (COAA) Gold Award, the 2005 CoreNet H. Bruce Russell Global Innovators of the Year Award, and the 2001 Tech Pono Award for Innovation in the State of Hawaii, along with numerous other awards (Kashiwagi *et al*, 2012).
8. The largest projects are $1 billion Infrastructure project in the Netherlands, $100 million City of Peoria Wastewater Treatment DB project; $53 million Olympic Village/University of Utah Housing Project (Kashiwagi *et al*, 2012).

The former Associate Vice-President of Arizona State University Business Services, Ray Jensen, who led ASU to deliver $1.7 billion of services at ASU, commented on PIPS, saying, "I have been successful in the business of procurement and services delivery for the past 30 years. I saw in PIPS, improved solutions of performance/contract administration issues that are so dominant, that I am willing to change my approach to the business after 30 years" (Kashiwagi, 2013).

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Outside groups have analyzed the BV PIPS system multiple times in the last 17 years. However, three investigations performed a thorough study on the impact and effectiveness the BV PIPS system has had on 100+ unique clients:

1. The State of Hawaii Audit (State of Hawaii PIPS Advisory Committee, 2002; Kashiwagi *et al*, 2002).
2. Two Dutch Studies on the Impact of PIPS (Duren JV & Doree A, 2008).

The studies confirmed that the performance claims of the PIPS system were accurate. Duren and Doree's study found the following for BV PIPS projects performed in the United States (2008):

1. 93.5% of clients who worked with BV PIPS identified that their projects were delivered on time.
2. 96.7% of clients who worked with BV PIPS identified that their projects were delivered within budget.
3. 91% of the clients stated that there were no charges for extra work.
4. 93.9% of the clients awarded the supplier's performance with greater than an 8 rating (on a scale from 1-10, 10 being the highest performance rating).
5. 94% of clients would hire the same supplier again.

Currently, the BV PIPS is used mainly as a procurement/risk management system, but also has project management applications. The BV PIPS minimizes the complexity of increasing project sizes and supply chain participants by creating transparency using performance information. The author propose the BV PIPS as a potential solution to improve VCI performance due to the following reasons:

1. BV PIPS is the only identified system with sufficient documentation showing that it can deliver projects on time, on budget, and with high customer satisfaction.
2. BV PIPS has been tested in multiple countries and regions and shown similar results in all of them.

Conclusion

The construction industry in Vietnam has been growing consistently in recent years. However, the majority of projects are still suffering from non-performance issues mainly caused by construction participants. Multiple studies have identified the causes of non-performance in the VCI and have recommended directions to improve current delivery method. The BV PIPS model has been identified as a potential solution for issues in the VCI. Due to a limitation in information available, the author recommends that future efforts should be spent to quantify and document the current VCI performance and utilize the expertise of the BV PIPS creator to determine whether BV PIPS can be applied in Vietnam.

Recommendation

Due to limited amount of research readily available, the author could not obtain any data post-2014. Hence, the author recommends that a full research should be conducted to update the

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current VCI performance information and issues. Additionally, further effort should be spent on identifying whether the BV PIPS model truly aligns with the VCI issues, and if the creator of BV PIPS should be utilized for his expertise and advice. Finally, upon verifying the validity of the BV PIPS model, a pilot test could be carried out and studied.

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The Value of Alpha SPF Roofing: An Alpha Case Study at William Lipscomb Elementary School

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An Alpha roof is a type of Spray Polyurethane Foam (SPF) roofing system that has been documented to be one of the highest performing roofs in the industry. Despite the high level of performance of the Alpha SPF roofs, owners still try to protect themselves by purchasing warranties. When the Dallas Independent School District (DISD) did not receive enough funding to purchase the Alpha roofs for their school buildings, general contractors started shopping the Alpha contractors. The demand for Alpha roofs during DISD bond programs exceeded the supply of Alpha vendors. DISD lowered the requirements and the contractors and manufacturers delivered lower quality roofs. DISD still required the performance of the Alpha roofing system, even though they bought lower performing systems without the quality control requirements of the higher performing Alpha roofs. DISD was not happy with the lower performance on some of the inexpensive roofs. This paper describes a case study that proposes that high roof performance is a result of expert contractors proving their past performance, detailed preplanning, manufacturers doing quality control, contractors tracking their time and cost deviations and independent third party inspections. The expert Alpha contractor completed the project with the best dimensional stability metrics (dimensional stability is a metric of long lasting roofs). The roof installation was completed in 20 days and saved DISD over 20% of the cost of the roof, despite an increase in the scope of work. It was the first DISD project that had no punch-list items after the final walkthrough. DISD was extremely satisfied with the roof and the Alpha program demonstrated its effectiveness in the installation of roofs.

Keywords: sprayed polyurethane foam, Alpha roofing, SPF, Weekly Risk Report.

Introduction

The Sprayed Polyurethane Foam (SPF) is a lightweight renewable roofing system. If installed correctly, SPF roofing systems have great value due to their insulating properties, and ability to be installed over existing built up roofing systems. This minimizes environmentally hazardous material disposal of the traditional built up roofing (BUR) system (which the SPF roof system can encapsulate).

SPF roofing systems make up less than 3% of roofs in the industry (Kashiwagi, et. al, 2016a). The main drawback is the highly technical installation requirements of the two-component SPF roofing system that is installed in place. The correct installation of the SPF system is the most challenging and risky component of the roof system. This makes the performance of the system dependent upon the expertise of the contractor. The number of contractors who can install the system properly in the United States has been declining (PBSRG, 2016b).

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Owners have attempted to require manufacturer's warranties to ensure a 20-year performance of SPF roof systems. By observation and industry documentation, the industry has spent over 35 years trying to ensure performance through warranties; this approach has not been successful. The roofing industry does not have a good record of honoring warranties. Over 80% of all building construction problems involve roofing and waterproofing (Gajjar, et. al, 2014). Many SPF manufacturers utilize the warranties as a marketing gimmick. After the initial year of bonding responsibility has elapsed, manufacturers use the following techniques to invalidate the warranty (Lindus, 2015; Morin, 2017; Roofing Southwest, 2016; Shultz, 2016):

1. Use warranty clauses to nullify the warranty if the owner does not perform annual inspections and maintenance of their roof, did not keep debris off the roof, modified their roof equipment without proper notification to the manufacturer, walked on their roofs without authorization, or did not report problems in a timely manner.
2. Warranty only covers roof leaking. It does not cover system defects such as blistering of the SPF.
3. Identifies the leak was caused by an issue the warranty does not cover.
4. Contractor and Manufacturer will not respond to the owner.
5. Manufacturer will blame the cause of the leak on the improper installation by the contractor.

One way that has been successful in ensuring high performance of SPF roofs when a lower performing contractor is used, is by a manufacturer's quality control system. This is the Alpha SPF roof program which ensured the quality control system, preplanning from contractors, and a third party roof inspection that compared the installed urethane coated SPF roof system to the required thicknesses and performance metrics of the specifications.

The Alpha SPF roofing system has been documented as a high performing system (Kashiwagi, et. al, 2016a). It is made of two components: the sprayed polyurethane foam (SPF), and the highly protective urethane coating system (protects against UV degradation, foot traffic, and hail damage). The Alpha roof has also been proven to protect a building against severe hail, having passed the Factory Mutual Severe Hail test (1.75 diameter hailstones) on existing roofs multiple times (Kashiwagi, et al, 2016b; Zulanas, 2017). Contractors installing the Alpha roof systems must be a certified member of the Alpha program. The Alpha program requires contractors to maintain a high level of performance on all roofs they install.

The Dallas Independent School District (DISD) recognized the value of the system and used the Alpha roofing system to protect many of their buildings. Being in a location that receives hail regularly, DISD found the roof to be a great value proposition for its buildings. They have been putting the Alpha SPF roof on their buildings for the past 30 years.

Since 1987, Neogard has implemented the Alpha roofing program to identify the best contractors in the industry and to measure the performance of their roofs. As a result of Neogard's motivation to change the industry, the performance on Alpha roofing system has been heavily documented. Table 1 (a-c) includes the Performance Metrics of Neogard's Alpha Contractors, Alpha Contractor Requirements, and an Overview of Neogard's Coating Warranty Coverage (PBSRG, 2016b):

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Table 1a: Alpha Roofing System Performance Metrics (PBSRG, 2016b).

No	Neogard's Alpha Program	Unit	Overall
1	Overall customer satisfaction of Alpha Contractors	(1-10)	**9.5**
2	Oldest job surveyed	Years	**36**
3	Age sum of all projects that never leaked	Years	**29,714**
4	Age sum of all projects that do not leak	Years	**37,057**
5	Percent of customers that would purchase again	%	**99%**
6	Percent of jobs that do not leak	%	**100%**
7	Percent of jobs completed on time	%	**98%**
8	Percent of satisfied customers	%	**100%**
9	Percent of inspected roofs with less than 5% ponded water	%	**90%**
10	Percent of inspected roofs with less than 1% deterioration	%	**95%**
11	Percent of inspected roofs with less than 1/4" slope	%	**62%**
12	Average job area (of jobs surveyed and inspected)	SF	**30,698**
13	Total job area (of jobs surveyed and inspected)	SF	**230M**
14	Total number of jobs inspected	#	**2,286**
15	Total number of different customers surveyed or inspected	#	**2,834**
16	Average number of returned surveys per contractor	#	**23**
17	Total number of returned surveys and inspections	#	**5,223**

Table 1b: Alpha Roofing System Performance Metrics (PBSRG, 2016b).

No	Neogard's Alpha Contractor Requirements	
1	Minimum years of experience	5
2	Random survey of roofs	Every other year
3	24 hour response to leaks	Yes
4	Warranty covering labor	Yes
5	Maintenance inspection programs	Annual

Table 1c: Alpha Roofing System Performance Metrics (PBSRG, 2016b).

No	Neogard's Alpha Coating 15 Year Warranty Coverage	
1	Bird Pecking	Yes
2	FM-SH Hail Test 4470 (1.75 inches)	Yes
3	90 MPH Wind	Yes
4	Full maintenance	Yes
5	Independent third party testing	Yes
6	Proprietary details	Yes

These performance metrics document significant results in the SPF roofing industry. The Alpha roof system has shown consistent high performance (9.5 out of 10 customer satisfaction rating and 99% of customers saying they would purchase an Alpha roof system again) on over 229 million square feet (SF) of surveyed roof. Neogard's Alpha Roofing System's past performance outmatches any other roofing system's performance history (Zulanas, 2017).

The Alpha SPF roof system has the following attributes (Kashiwagi, 2016; Kashiwagi, 2015):

1. It is lightweight.
2. It is renewable.
3. It is hail resistant to hail sizes up to 1-3/4 inch hail as tested by the Factory Mutual Severe Hail (FM-SH) test 4470 within the 15-year warranty period.

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4. It is green as it provides the highest insulating value and minimizes the need to remove the existing BUR roof system. All new traditional 20 year modified bitumen roofs require the removal of the existing roof system.

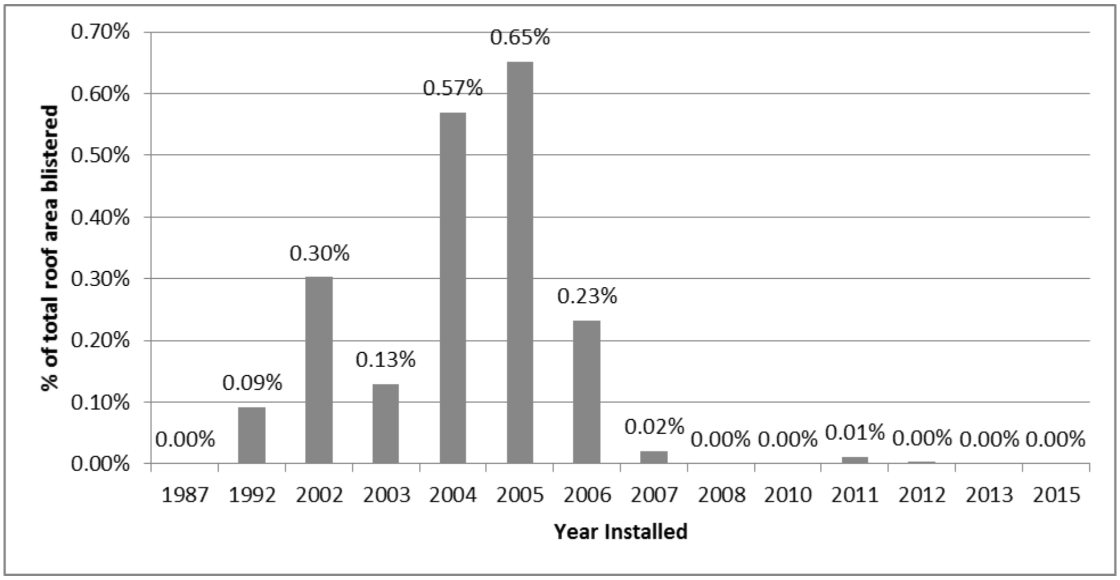

Figure 1: Yearly roof analysis showing blistered percentages of roofs (Zulanas, 2017).

Table 2: Roofs installed at DISD per year.

Year	# of Roofs Installed
1987	1
1992	1
2002	3
2003	1
2004	15
2005	28
2006	11
2007	4
2008	1
2010	5
2011	12
2012	9
2013	6
2015	1
TOTAL	**98**

In the mid-1980s, DISD needed to replace some of their roofs, but did not have enough funding to meet the requirement of traditional modified bitumen roofs. Due to the lower cost of the Alpha roof system, Alpha roofs were specified (up to 33% lower cost) (Kashiwagi and Pandey, 1999; Zulanas, 2017). When the costs for Alpha SPF roofs were still outside of their budget in the early 2000's, DISD specified that they required lower costing SPF roofs (minimum coating millage for ten year roof warranties) of the same quality. Due to the lower requirement for ten year roofs (instead of the Alpha 15 year hail warranty), the Alpha manufacturers did not perform the careful review of contractor preplanning, quality control system including pre-planning activities,

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tracking of time and cost deviations, and third party inspection. Figure 1 shows the lack of quality of installation based on the percentage of roof area blistered.

The DISD construction management group then made crucial mistakes. They allowed the general contractors to shop the Alpha contractors for lower prices. They also allowed a low bidding contractor to take a majority of the work. The manufacturers did not enforce the Alpha program technical requirements (preplanning, track risk, time, and cost deviations, and have third party independent inspections). Some of the roofs did not perform well (Figure 1 and Table 2). The DISD engineering group was discouraged with the poor performance and minimized the use of the Alpha SPF roof system, regardless of the lower cost.

DISD did not understand that in order to install high performing roof systems, they needed to hire high quality contractors who would install high quality Alpha SPF roof systems and ensure that they had a quality control plan in place. They also did not realize that the length of the warranty is immaterial to ensuring a high performing roof. DISD installed over 4 million square feet of the Alpha SPF and additional lower costing SPF roofing systems. When installed correctly, the Alpha SPF systems performed for 25 years, with a recoat capability to last another 15 to 20 years, as documented by the Casa View Roof and the Fosters Elementary Roof Hail Testing (Kashiwagi, et al, 2016a; Kashiwagi, et al, 2016b). However, when DISD adjusted the requirements and allowed the general contractors to hire the lowest costing roofing contractors they received roofs that were installed incorrectly and the roofs did not perform as expected. DISD expected the 10-year warranted roofs installed by low bidding contractors to last beyond their 10-year warranty period. When installed correctly, the Alpha SPF roofing systems exceeded their performance expectations. The Alpha Program's performance metrics on DISD projects can be seen on Table 3.

Table 3: Alpha Roofing System Performance Metrics at DISD (PBSRG, 2016b).

Criteria	**Unit**	**Value**
Total years working with the Alpha Program	Years	**14**
Oldest job surveyed	Years	**27**
Average age of jobs surveyed	Years	**8**
Age sum of all projects inspected	Years	**699**
Average total repairs on each roof	SF	**481**
% of roof repaired	%	**1.01%**
Total blisters	SF	**13,575**
Average total existing blisters on each roof	SF	**154**
% of roof blistered	%	**0.32%**
Average blister size	Inches	**2”**
Average job area (of jobs surveyed and inspected)	SF	**42,208**
Total job area (of job surveyed and inspected)	SF	**4.2 M**
Total number of jobs inspected	#	**100**

Problem

Despite the high performance of the Alpha systems, because DISD allowed low performing contractors that did not adhere to the Alpha program to install roofs on their buildings, there were SPF roof systems that failed and had to be removed. Table 4 is a list of roof systems, which

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were irreparable, and were removed and replaced by modified bitumen (MB) roof systems. The owner blamed the manufacturer for the failed roofs because the manufacturer had issued a warranty. The problem is complicated because each SPF roof system has two major manufacturers: the manufacturer of the protective polyurethane coating and the manufacturer of the SPF system. The SPF manufacturer blamed the contractor for faulty installation, and would not fix the roof. In their defense, the contractor is most likely the cause of SPF problems. This is supported by the performance information of failed DISD SPF roof systems.

Table 4: DISD Failed SPF Roof Systems from Alpha Contracting.

Job Name	Foam Man.	Year Installed	Warranty Expiration Date	% of Roof Blistered	Total Roof Size	Total SF of blisters
Russell ES	BASF	2004	10/29/2014	3.85%	27,295	1,050
Samuel HS	BASF	2005	8/26/2015	2.71%	147,500	4,000
Spruce HS	BASF	2005	8/26/2015	2.53%	85,000	2,150
Lincoln HS - Flat	BASF	2006	NA	1.92%	12,000	230
Hawthorne ES	BASF	2005	7/30/2015	1.46%	45,200	660
Russell ES - Old Admin Bldg.	UCSC	2004	10/29/14	1.43%	10,500	150
Terry ES	BASF	2004	12/8/2014	1.13%	28,400	320
Peabody ES	UCSC	2005	7/31/2015	1.07%	32,600	350
Mills ES	UCSC	2005	8/3/2015	0.69%	14,300	98
Rangel Women's Leadership School / SJ Hay	BASF	2004	NA	0.53%	12,000	63

The performance information on the failed roofs identified the following:

1. All the failed roofs were installed by one contractor that did the work for very low prices.
2. The contractor used a SPF that was not pre-approved on three of the roofs.
3. The contractor and manufacturer did not perform quality control on the roofs.
4. DISD continued to allow the contractor to install their roofs due to their low prices. The manufacturer and Alpha Program allowed the contractor to remain in their programs as well.

PBSRG recommended to DISD and the manufacturer of the Alpha SPF protective coating that attempting to minimize the risk of nonperformance through warranties was not effective in repairing the poorly installed SPF roof systems. PBSRG designed a new approach that ensured the correct installation of the Alpha SPF roof system.

However, because of the failed roofs, the DISD engineering group did not feel the performance of the Alpha SPF roofing system was an economical option when compared to a 20-year MB roofing system. Roof installation websites claimed that SPF roofs require more maintenance than MB and require recoating every 10 years (Improvenet, 2014). Additionally, other sites claim that based off cost and maintenance, built up roofs and MB are the best value, lasting up to 30 years (Maintenance Solutions, 2015). However, a study of Carnegie Melon's roofing system over 20 years found that the average cost of roof replacement, including the repairs for MB roofs was $269 per square meter, equivalent to $24.75 per square foot with an average leak rate of 5.2 leaks per building per year (Coffelt, 2010). The roofing expert for DISD reported that the average price to apply a traditional MB roof, with tear off, on a commercial building is approximately $16 to $19 per square foot. Today, most SPF roofs at DISD are being replaced by costlier MB

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roofing systems even though the cost of the recoating and maintaining the Alpha SPF roof system is half of the MB system. (Casa View Roof and the Fosters Elementary Roof Hail Testing; Kashiwagi, et al, 2016a; Kashiwagi, et al, 2016b).

Proposal

PBSRG proposed that the only way to minimize the risk of nonperforming SPF roofs was to:

1. Assist the Alpha contractor to identify the roof requirement before they installed the SPF roof system.
2. Force the Alpha contractor to identify if the SPF roof system could actually be used successfully on the roof being considered.
3. Have the Alpha contractor provide a weekly risk report (WRR), to all stakeholders that would track the project's schedule and cost and time deviations. This would create transparency and minimize disagreements between parties when issues occurred on the project.
4. Identify the contractor as the key to high performance.
5. Identify that the contractor selected has the capability to perform, by showing past performance and by making them responsible to minimize the risk of nonperformance of the Alpha SPF roof system through pre-planning and documenting project performance.

Methodology

The following steps were accomplished in 2015 and 2016:

1. A quality assurance and quality control system was developed for the Alpha SPF roof system.
2. Responsibility of the SPF defects was moved from the coating manufacturer to the SPF manufacturer or the contractor. If the contractor does not fix SPF defects, they would be removed from the Alpha Program (a requirement for contractors to bid on DISD SPF roof projects).
3. Ran a case study of the installation of an Alpha SPF roof system utilizing the quality control system and collected documentation on the performance of the project.
4. Conducted an analysis of the performance of the roof installation.

Development of the Quality Assurance and Quality Control System

The initial Alpha Program was based on past performance of roofs installed and customer satisfaction of the clients of the roofs. The Alpha Program manufacturer (of the protective polyurethane coating) did not want to take the liability of the installation of the SPF roof system. However, to convince DISD of the value of the Alpha SPF roofing system, they provided them with a manufacturer's warranty that covers all SPF defects. The manufacturer only agreed to this

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warranty if the contractor that installs the roof is part of the Alpha program. To be a part of the program the contractor has to maintain the following performance requirements:

1. 98% of all roofs not leaking.
2. 98% customer satisfaction.
3. Annual surveys of all SPF roofs installed.
4. An inspection every other year of 25 or more roofs being installed.
5. Response to a leak or customer dissatisfaction within a week.
6. Fix defects within two weeks unless given more time by the owner's representative.

If the contractor does not keep the above requirements, they are removed from the Alpha Program. DISD is the only owner of SPF roof systems that has the Alpha Program motivating contractors to fix any defects on their roof systems.

The contractor responsible for the low performing DISD roofs (that led to replacement) received satisfied responses every year from the DISD roofing manager. DISD was therefore partially responsible for the failed roof systems because the DISD roofing manager provided satisfied responses, indicating the job was being performed correctly. The contractor finally went out of business, possibly when faced with having to take responsibility for their failures. The Alpha manufacturer was also connected to the defects because the replaced roofs were not quality controlled by the manufacturer and the contractors were not required to identify the requirements of the unique roofs by third party inspections.

PBSRG modified the Alpha Program with the following changes:

1. The contractor would have to hold a clarification meeting at the roof site with all stakeholders (client, roofing engineer/consultant, contractor, manufacturers of Alpha coating and SPF) before the contract award. The contractor would be required to keep the meeting minutes.
2. The contractor would have to run a moisture survey of the roof. A wet existing roof system is the largest risk to a properly installed SPF roof system.
3. The contractor would be required to run a WRR that identifies the performance metrics of temperature, moisture, time and cost deviation from the planned schedule.
4. Third party inspection and identification of performance metrics of the installed SPF (compressive strength and thicknesses) and protective Alpha coating (adequate thickness).
5. The Alpha coating manufacturer issues a 15-year hail warranty on the coating.
6. The contractor is responsible to maintain the condition of the SPF through annual inspections of their roof systems. If the contractor can get their SPF manufacturer to write a warranty to cover all SPF defects, the client gets an additional guarantee and the contractor gets the manufacturer's support. The Alpha coating manufacturer does not have to be responsible for SPF defects.

The researchers proposed to the DISD that this was the most comprehensive SPF roof warranty and quality control system in the industry. Regardless of manufacturer's reaction to warranty claims, DISD insisted on using warranties.

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Dallas Fort Worth Urethane (DFWU) is the highest performing SPF contractor servicing DISD (longevity of performance, customer satisfaction, no leaks, and no needed repairs). DFWU does not have any claims for blistering roofs against SPF manufacturers. DFWU identified that they do not have any outstanding blistering claims on their SPF roof systems and have repaired any SPF defects on the roofs installed at DISD.

Due to their high performance, DFWU, requested and received from their SPF manufacturer, to write a warranty covering all SPF defects (regardless of source of risk). This is the only SPF manufacturer warranty in the industry with this stipulation. The only contractor in the Alpha Program currently covered by this warranty is DFWU. The performance of DFWU resulted in a warranty that minimizes the risk for DISD. By observation, because there has been no risk of unrepaired SPF roof system defects on roofs by DFWU, the warranty is issued. The warranty is not the risk mitigation mechanism. The risk mitigation mechanism is the high performance of DFWU. This is the intent of the high performance Alpha Program. DFWU performance and performance with DISD are shown in Tables 5 and 6.

Case Study at William Lipscomb Elementary

In the fall of 2015, DISD, the 14th largest school district in the United States, bid out a roofing recoat project for William Lipscomb Elementary. Using a Job Order Contractor (JOC), DISD allowed the contractor to bid out the roofing work to non-traditional roofing applicators, such as Alpha SPF roofing applicators. After reviewing multiple bid proposals, the group did not select the low bid offer, but selected DFWU, a roofing applicator part of the Alpha program.

Throughout their participation in the Alpha Program, DFWU, had been noted to be one of the best SPF roofing applicators in the entire country (see Table 5). DFWU's performance record at DISD is listed in Table 4. DFWU additionally agreed to film the course of the entire project to give additional documentation of the installation.

Table 5: DFWU 4 year Performance Line (PBSRG, 2016a).

Criteria	Unit	2015	2013	2011
Overall customer satisfaction – Contractors	(1-10)	10.0	9.8	9.8
Oldest job surveyed	Years	36	27	25
Average age of jobs surveyed	Years	13	9	10
Age sum of all projects that never leaked	Years	715	477	397
Age sum of all projects that do not leak	Years	794	427	523
Percent of customers that would purchase again	%	100%	100%	100%
Percent of jobs that do not leak	%	100%	100%	100%
Percent of jobs completed on time	%	100%	100%	100%
Percent of customers who are satisfied	%	100%	100%	100%
Percent of inspected roofs with less than 5% ponded water	%	100%	96%	100%
Percent of inspected roofs with less than 1% deterioration	%	100%	85%	100%
Percent of inspected roofs with less than 1/4" slope	%	7%	79%	33%
Total job area (of job surveyed and inspected)	SF	2,694,878	2,912,287	2,374,091
Total number of jobs surveyed	#	50	51	50
Total number of jobs inspected	#	27	26	26
Total number of different customers surveyed & inspected	#	44	45	37

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Table 6: DFWU Past Roofs Installed at DISD.

Item	Unit	Earhart Elementary School	Pinkston High School
Foam Manufacturer	-	BASF	BASF
Street Address	-	3531 N. Westmoreland Rd., Dallas, TX	2200 Dennison St, Dallas, TX
Job Area	SF	30,500	161,500
Original Install Date	-	12/31/2004	7/13/2005
Warranty Expiration	-	12/31/2019	7/29/2020
Warranty Length	Years	15	15
Roof Performance on 8/25/2015			
Slope	Degree	0	0
Ponding	In SF	0	0
Granules or aggregate	-	G	G
Penetrations	SF	35	250
Blisters	SF	2	100
Delamination	SF	0	0
Mech. Damage	SF	0	0
Bird Pecks	SF	0	0
Repair	SF	160	300
Deterioration	SF	0	0
Avg. Blister Size	Inches	0	2
Blisters over one foot	#	0	0
Open blisters	#	0	0
Blistered	%	0.01%	0.06%
Repaired	%	0.52%	0.19%
Customer Satisfaction	1-10	10	10

The William Lipscomb Elementary had a 17,578-square foot built up roof over coal tar pitch with constant leaking problems over its 15+ years of service, see Figure 2 and 3 for pictures and drawings of the roof. The roof included two HVAC units, two 4" vents, miscellaneous plumbing stacks, gas line and one roof hatch. The roof hatch was scheduled to be screwed shut and foamed over. One of the reasons for utilizing the SPF roof system was savings of over $100,000 versus the removal of the existing system and installing the more traditional MB roof. The Alpha SPF roof may also extend the service life up to 45 years after two recoats of SPF, as was seen from the performance information on Alpha roofs installed at Casa View and Foster's Elementary school (Kashiwagi 2016a; Kashiwagi, 2016b).

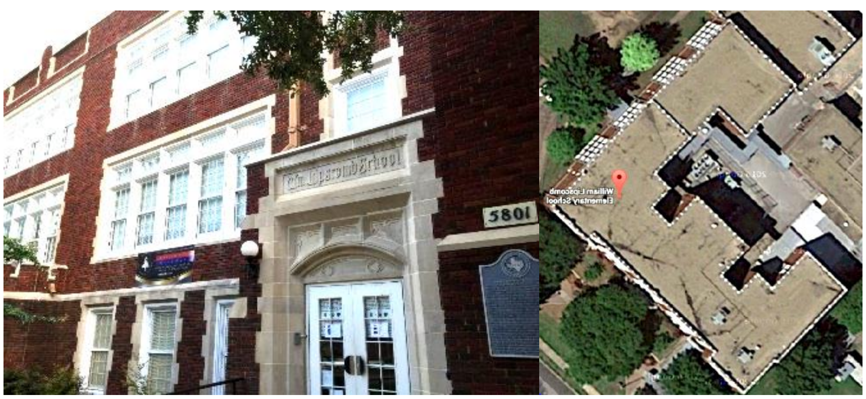

Figure 2: William Lipscomb Elementary School, DISD, Dallas TX.

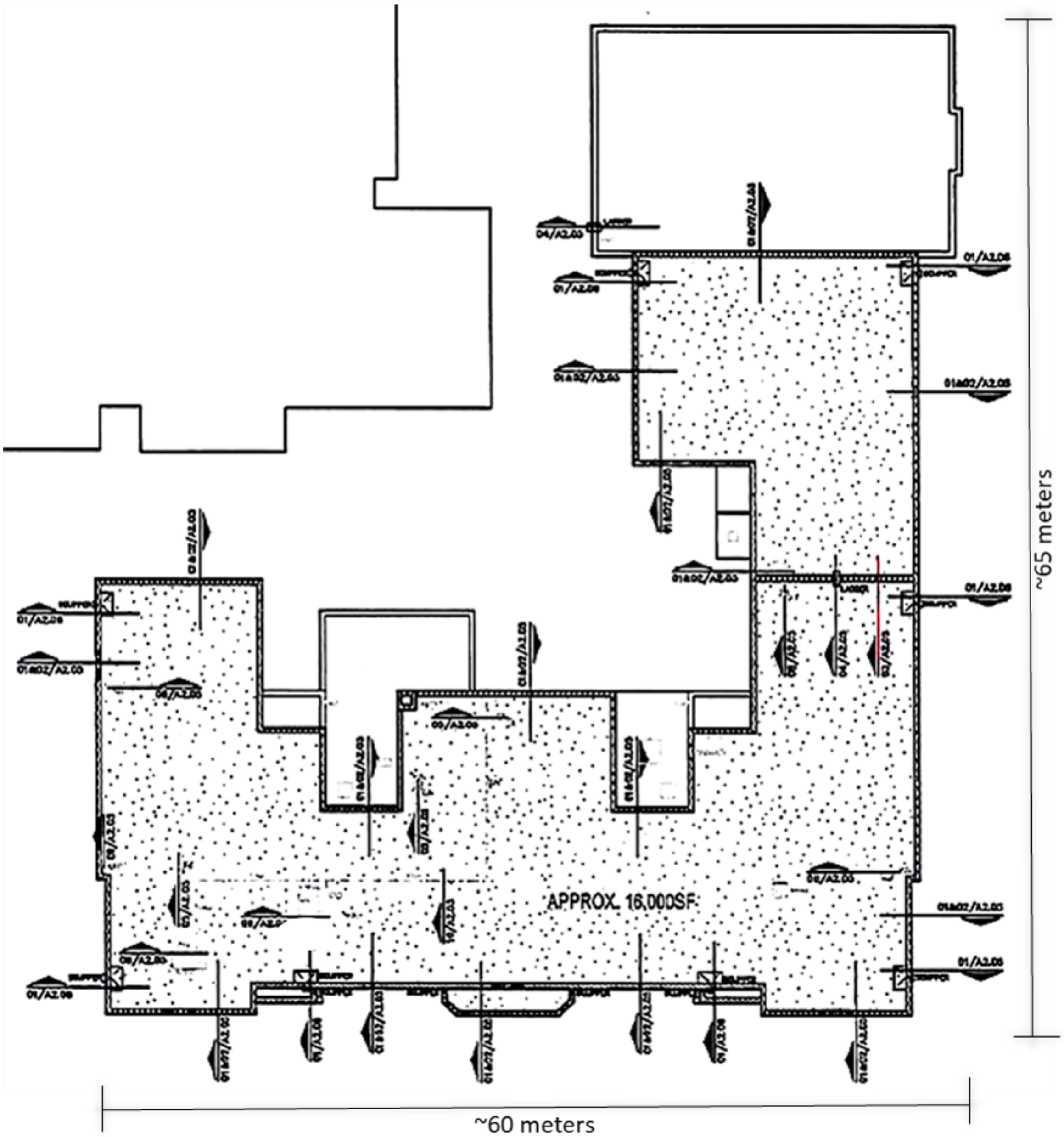

Figure 3: Overhead Roof Plan of Lipscomb Elementary School (1/16" scale).

Tracking Project Deviations

From the beginning of the project, DFWU utilized a WRR as part of the Alpha Program requirements. The WRR is composed of the following components:

1. A Project Setup tab - which describes the basic information on the project and the information that is known about the scope of work, contact information, the warranties and the level of expertise of the DFWU's SPF applicators.

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2. Progress Report tab (see Appendix A) – which is a weekly log that clearly shows what DFWU accomplished during the week, which the key stakeholders can view and understand what is being done on the project.
3. Milestone Schedule tab (see Appendix B) - which is the schedule for the project that is projected by DFWU. DFWU was required to create a milestone schedule at the beginning of the project. Throughout the project, DFWU would track the project to make sure every task was on schedule. Any part of the project that was not running according to schedule would have to have a risk number associated with it, which let the stakeholders know what caused the schedule to be delayed on the Risks tab.
4. Risks tab (see Appendix C) – this tab shows all of the risks that occur on the project that are causing deviations to the DFWU's anticipated scope. The risks tab shows the name of the risk, the contractor's plan to mitigate the risk, the effect of the risk to the project regarding time and cost deviations, the entity causing the risk and the severity of the risk.
5. Risk Management Plan tab - documents at the beginning of the project, the different potential risks that could occur on the project and shows how the contractor would be able to mitigate this risk from occurring on DFWU's project. The Risk Management Plan also allows the stakeholders to understand the repercussions of each of the risks should they occur, which motivates the stakeholders to ensure that they do not make that mistake.
6. Performance Metrics tab (see Appendix D) - provides quality assurance for the client by illustrating that DFWU is ensuring high quality work and is not taking shortcuts. In the case of the DFWU roof installation, the Performance Metrics tab shows the weather and roof conditions that could potentially affect the quality of the roof installation.
7. Report tab (see Appendix E) – this tab summarizes all of the previous tabs in order for the stakeholders to see the progress on the job without reading the details.

The WRR is sent out to the key stakeholders each week to assure the client that the project is running smoothly and to inform the clients and key stakeholders about any risks occurring or that might occur on the project. Initially, the Job Order Contracting (JOC) project manager and the Trevino Group (under DISD), attempted to manage the distribution of the WRR to key stakeholders. They argued incorrectly that the WRR was a contractual document, and would only be a communication medium to contact the client. The Trevino Group representative stated, "The Trevino Group is responsible to the Owner for this project, therefore, any schedules or documents required will need to go through me" (PBSRG, 2016b).

The WRR is not a contractual document, but information on the project that allows all parties to understand the project's progress. In attempting to control the distribution of the WRR, DFWU would have been unable to communicate their needs effectively to the client. Shortly after some clarification, the Trevino Group permitted the distribution of the WRR to the client on a weekly basis. The WRR provided transparency to all stakeholders when the schedule deviations occurred, eliminating disagreements between parties throughout the project and after the project.

Time Deviations

DFWU continually tracked the time deviations throughout the project to minimize the impact of the client delays, and still finish the project with their modified schedule of 6/8/2016. DFWU finished the project in less than 20 days after final approvals by DISD. DFWU finished the project on time as shown in Table 7, despite many delays caused by the owner. Table 7 also shows which risks affected the project activities.

Table 7: Milestone Schedule Completion.

Activity	Initial Schedule Finish	Actual Schedule Finish	Initial Duration of Task (Days)	Actual Duration of Task (Days)	Risk #
Clarification Meeting at Lipscomb	3/16/2016	3/16/2016	1	1	
PO Issue by DISD	3/15/2016	3/31/2016	1	16	4
Moisture Study	3/26/2016	4/8/2016	1	1	4
Notice to proceed from Architect (Review of submittals)	3/26/2016	4/25/2016	11	41	5
Mobilize/Set-up Safety	3/22/2016	4/29/2016	7	16	4, 5
Gravel Removal	4/7/2016	5/6/2016	3	3	4, 5
HVAC Units Raised/Scuppers Installed and all sealed-in on High Roof.	Added to Scope	5/7/2016		1	
3 small lower roofs added to project by architect.	Added to Scope	5/21/2016		2	
Foam - Including Small Lower Roofs & Roof Hatch	4/6/2016	5/21/2016	7	10	1,5
Coating - Base/Intermediates - Including Small Lower Roofs & Roof Hatch	4/16/2016	5/23/2016	11	10	1,5,8
Coating - Top Coat - Including Small Lower Roofs & Roof Hatch	4/27/2016	5/24/2016	12	3	5,8
Granules - Including Small Lower Roofs & Roof Hatch	5/3/2016	5/24/2016	7	3	5,8
Roof Hatch - Decision to Leave As Is - Decision to Eliminate	-	5/24/2016	1	4	2, 3,5
Demobilize/Punch Out	5/4/2016	5/24/2016	2	2	5
Project Completion	5/4/2016	5/25/2016			5
DISD Inspection/Walk Thru - Zero Punch List	5/31/2016	6/7/2016			
Third Party Inspection	5/31/2016	6/8/2016			

Some of the major setbacks on the roofing installation included the following:

1. DISD delayed signing the purchase order until March 31, though the bid had been won by DFWU in January.
2. DFWU's subcontracted gravel crew was unable to work for one month due to the architect not signing the Notice to Proceed at the right time.
3. Delayed inspection and approval of DFWU's roofing installation permit by the Historical Landmark Commission.
4. DISD's decision on foaming over the small roof hatch, which was the only internal access point for DISD to get on the roof.

After a clarification meeting on 3/16/16, without a purchase order issued from DISD (normally contractors do not do anything until they receive a purchase order), DFWU documented all of the existing roof information at the school, identified the risks for the project and set up an initial schedule for how long the project would take. DFWU documented this information on a WRR so

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DISD and the Trevino Group (the Job Order Contractor who was given the task order) could be informed and up to date on the status of the project.

After receiving a Purchase Order from DISD on 3/31/16, DFWU planned to remove the gravel from the roof on 4/7/16 with hired subcontractors. The subcontractors had their machines ready for gravel removal at the school on 4/7/16. However, the architect was unaware that the submittal would cause the project to be delayed, and did not sign off on the submittal. As a result, DFWU lost 30 days on the project because the subcontractors were unavailable to complete the gravel removal later in the week due to other work commitments.
After the JOC contractor completed the necessary requirements (the week of 4/11/16), DFWU applied for a permit from the City of Dallas. The permit was put on hold due to not having a signed approval letter from the Historical Landmark Commission. DFWU had pre-notified the JOC contractor that this would be required, but they still did not receive it in time causing the delay. The risk that DFWU managed was that because William Lipscomb Elementary School was a historical building, the Landmark Commission would protest the project if the roof's coating was installed over the front of the building. On the other hand, if the termination point of the coating did not go over the edge of the front enough, it would have affected the Neogard manufacturer's warranty. DFWU worked with the architect who drew out new designs that were suitable for both parties, which eliminated any delay on the project.

The final delay on the project was the roof hatch. The roof hatch was originally scheduled to be left open on the architect's plan, but since the roof hatch did not comply with OSHA standards, DISD decided that the roof would be better accessed from exterior ladders that would be installed. The Historical Landmark Commission did not like the idea of installing exterior ladders, because it would deface the appearance of the existing historical building. DISD was notified that they would not be allowed to install a permanent exterior ladder in the future. After multiple discussions, DISD decided to have DFWU foam over and seal the roof hatch shut, the only roof hatch which provided facilities personnel access to the roof. Subsequent visits to the roof would have to be from an exterior, non-attached ladder (60-foot ladder is transported onsite by the roof inspector).

When DFWU was able to get the subcontractors on the roof to remove the gravel on 5/6/16, DFWU made quick work of the project. After seeing how quickly DFWU was progressing on the project, the architect increased their scope of work by adding three additional roofs to the project. Despite all of the events that caused and could have caused delays on the project and the increased scope, DFWU was still able to complete the entire 17,578 SF roof by the same completion date (6/8/2016). The entire installation was finished in 20 days from the time that the gravel was removed. The WRR helped DFWU to be able to demonstrate the schedule deviations to the key stakeholders to minimize disagreements and quickly find solutions to enable the on-time completion. The notable accomplishment achieved was that in addition to completing the project quickly, the roof had no punch list items. DISD said it was the first time in history of their roof inspections that this had happened (35 years of DISD roof installations).

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Performance Metrics

As part of the Alpha Program, DFWU was required to track the performance metrics of the roof and the weather each day that the applicators were working on the roof. The performance metrics were useful in that they ensured that DFWU did not perform a roof application while the roof was wet. If the roof were wet during installation, the performance of the roof would have been compromised. An SPF application upon a deck with significant roof moisture would create defects in the future. Additionally, if there were too much wind during the day, the spray of the SPF would be affected and could have resulted in poor long-term performance of the roof. An overview of DFWU's performance metrics throughout the William Lipscomb Elementary School roof installation are shown below (see Table 8).

Table 8a: DFWU Urethane performance metrics during the roof installation.

Category	Unit	Start of Day	End of Day
Wind Speed	Miles per hour	10.0	6.7
Humidity	Relative humidity (%)	71.3	61.7
Amount of water on Deck	Moisture Content	0.5	0.4
Temp. on the Deck	Fahrenheit	94.1	107.8

Table 8b: Moisture scans.

Date completed	4/8/2016
SF of roof with moisture	0

Table 8c: Foam Testing.

Time Period	Unit	Compressive Strength	Density	Dimensional Stability
Beginning	Pound-force per square inch	55.8	3	3.1
Existing		NA	NA	NA
Project End		60	3	3.1

For additional proof of the roof installation's quality workmanship, DFWU videotaped the entire roof installation of William Lipscomb High School, clearly demonstrating their expertise. If DFWU had installed the roof improperly, there would have been video evidence that the workmanship was at fault and the contractor would be required to pay for any roof defects. This eased the client's anxiety about the roof installation and clearly showed that the workmanship would not be at fault for any future roof defects. Additionally, DFWU used the video as promotional material for clients to see their expertise and to demonstrate how the SPF application works, not only providing workmanship quality assurance but marketing material for the high performance Alpha contractor as well. Comparative before and after photos of the roof are shown in Appendix F.

Cost Deviations

DFWU did not have any change orders that affected the cost of the project. Due to pricing confidentiality, the researchers cannot release the exact pricing figures concerning the roof. However, the roof saved over 20% in costs on the roof installation compared to the traditional built up roof.

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The estimated cost of continuing the Alpha roof service of the William Lipscomb Elementary roof in 20 years will be approximately $6.00 per square foot for an Alpha coating recoat ($105,468). The cost of tearing off the existing system and installing a new traditional MB roof on the same roof is $19.91 per square foot ($350K, if the current cost will still be valid in twenty years). This can be compared to removing the MB roof system in twenty years and installing a new MB roof system. The savings in 20 years of recoating the Alpha SPF roof system would be $244,532 (69% savings with the Alpha SPF system recoating in 20 years).

Additional comments from John Ewell, from DFWU, demonstrating additional cost savings are as follows:

> *"The Lipscomb school was built with a flat concrete roof deck and for drainage a tapered insulation board was installed under the BUR. These tapered insulation systems are very expensive. For a R20 value the cost runs in the $4 per s/f range. The removal of the BUR would cost approximately $2.50 to 3.00 per s/f. The urethane system installed was a straight 3 inches (R20) on a flat roof. Additional foam would be needed for proper drainage at approximately $2-3 per s/f for sloping the foam. The cap stone was also a problem re-mortaring the joints. I estimate the cost savings for installing the Neogard coating system to the top of the cap stone instead of cleaning out the joint between the stone and installing new mortar at approximately $35,000. The total cost savings is over $100,000. Currently the roof has a R40 insulation value and meets the department of energy's Energy Star reflectivity rating. The DFW Urethane/Neogard/Alpha SPF option was a much faster system to install because the roof was not removed. The school being located in a neighborhood, we saved several trips hauling debris, which would have disturbed neighbors and also helped save space in our landfills. This was a wise sustainable option for DISD. DFW Urethane was able to install the urethane roof during school. At Lipscomb Elementary they have minimal parking in the teachers' parking lot. The principle agreed to give us 8 spaces for our shipping container, and spray rig. It would have been a major inconvenience to do BUR. In order to install a BUR, it would require three times the parking spaces and half the playground. Additionally, the number of people required to install a BUR is 5 times the man power, which requires more DISD supervision."*

In the short term and in the long term, Alpha SPF roofs are a better economic value for DISD compared to the traditional MB roof. Based off this data, the roofs will last longer (Kashiwagi, et. al., 2016), save on energy and are inexpensive to recoat compared to the traditional MB roof.

Third Party Roof Inspection

Upon completion of the roof installation, as part of the Alpha Program requirements, a third party must inspect the quality of the roof installation. The third-party inspection group was Penta Roofing Consultants. Penta took three core samples and 6 slit samples from the completed roof at the end of the project of which they lab tested for defects and to determine the quality of the installation. Their results are as follows in Figure 4, 5, and Table 10 and 11.

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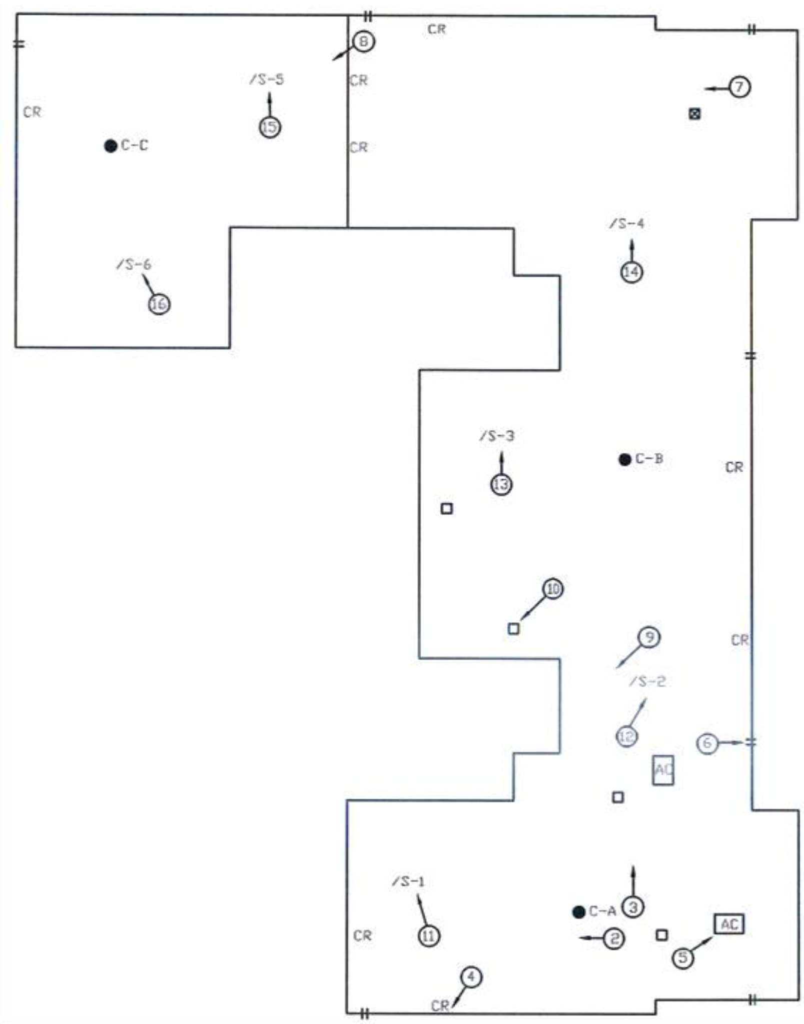

Figure 4: Map of William Lipscomb Roof with Core and Slit Samples (not to scale).

Location of core and slit samples on William Lipscomb Roof are indicated at C-A, C-B, and C-C (see Figure 4). The locations where the slit samples were taken are indicated at S-1, S-2, S-3, S-4, S-5, and S-6. The numbers 1 through 16 that are circled are the specific areas where the third-party inspector took a picture for their report, and the arrow from the numbered circle indicates the direction the picture was taken.

Table 9: William Lipscomb Core Sample Data.

Location	A	B	C	Average
# of Foam Layers	5	5	4	4.67
Foam Thickness (in)	3.4	3.5	4.5	3.8
Coating Thickness (mils)	59.0	62.0	58.0	59.7
R Value	23.1	23.8	30.3	25.7
Density (pcf)	3.8	3.9	4.0	3.9
Compressive Strength (psi)	53.0	67.0	61.0	60.3

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R-values were calculated on the above Table 9 by taking the foam thickness and adding 1 inch of concrete roof deck and applying the figures into the R-value calculator found at ekotrope.com (Ekotrope, 2016). The R-value above far exceeds the minimum Alpha states that it will provide, which is an R-value of 10.5.

Table 10: William Lipscomb Slit Sample Data.

Slit Sample ID	**1**	**2**	**3**	**4**	**5**	**6**	**Average**
Number of Coats	3	3	3	3	3	3	3
Coating Thickness (mils)	59	58	62	70	56	58	60.5
Foam Thickness (in)	3.3	3.8	4	4	4	4	3.85

The Alpha Program requires that the minimum Alpha roof coating thickness of the SPF application is 45 mils and SPF with a 50-PSI compressive strength. The coating thickness and compressive strength listed on Table 9 and 10 show that the roof surpassed the minimum Alpha SPF application requirements. Thom Tisthammer, from Wattle and Daub, states that the William Lipscomb Elementary School's foam dimension stability numbers are the "best in the industry."

Based off the third-party roof inspection on 6/8/16, the following information was compiled:

Inspection Type	Initial	**Building Name**	Lipscomb Elementary School
Coating System	Neogard 70613	**Address**	5801 Worth St., Dallas, TX 75214
Minimum Coating Thickness	50.0 mils.	**Company**	Dallas ISD
Foam Manufacturer	Covestro, LLC	**Roof Size**	17,578 SF.
Foam System	Bayseal 3.0	**Building Use**	School
Substrate Type	Silicone/Foam	**Penta Inspector**	Jim Sangster
Construction Type	Remedial	**Inspection Date**	6/8/2016
Granule Color	White	**Inspected With**	John Ewell - DFW Urethane
Uniformity	Acceptable	**Reviewed By**	John T. Hatfield
Days Since Rain	3 Days Prior		
Owner Satisfaction	Satisfied		
Owner Comments	None		

Figure 4: William Lipscomb Roof Inspection Report.

The roof received two separate 10 out of 10-customer satisfaction ratings on the project for customer satisfaction and quality from the third party inspector at Penta and from the owner. An additional comment from Corrine Berti-Craig, Trevino Group representative, who was the JOC contractor representing DISD on the job, stated, "(DFWU) did a wonderful job."

Contractor Warranty Coverage

DFWU agreed to provide a 15-year workmanship warranty on the roof, agreeing to repair any leaks or damages on the roof due to workmanship. This workmanship warranty is 3 times the required workmanship warranty on Alpha roofs (5 years). In addition, Covestro, the foam manufacturer, provided a 15-year warranty on the foam. The industry standard and DISD's normal standard for SPF roofing specified the installation of foam manufactured by BASF or an equivalent quality foam. However, BASF did not provide any foam manufacturer's warranty on his or her foam to anyone at any time. Covestro providing a foam manufacturer's warranty for

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the entire warrantied service life of the roof is above the standard for the industry. Finally, Neogard agreed to provide a coating warranty for 15 years, which is the Alpha standard coating warranty. Neogard's coating warranty covers bird pecking, FM-SH hail (1.75 inches), 90 mph wind, full maintenance, and independent third-party testing and proprietary details for all 15 years. Traditional warranties provide 20-year warranties, but never actually fix the roofs if there should be a defect because they will blame the coating applicator. Neogard takes total accountability and offers a 15-year coating warranty (Kashiwagi, et al., 2015).

Conclusion

The DISD facility management/construction delivery group is not specifying the Alpha SPF roof system. A careful analysis of the cost and performance of the DISD delivery of roofing systems has identified the Alpha SPF roof system as a high-performance system, which is a better value than the new modified bitumen traditional roof system being specified by the DISD engineers.

This study is a case study of an Alpha SPF roof system installed by a high performing contractor. Utilizing the expert Alpha SPF contractor, the roofing system installed saved DISD substantial savings. The approach used on this project is the JOC contract approach. The approach used an Alpha program approach that required contractor preplanning, contractor tracking time and cost deviations of the project, and manufacturers supporting the Alpha contractor with a 15 year warranty on the sprayed polyurethane foam (riskiest part of the Alpha SPF system) and a 15 year warranty on the Alpha urethane protective coating. The author, who has tracked the Alpha program for the duration of the Alpha SPF program, proposes that this roof is the highest performing Alpha SPF roof system installed, with the most meaningful warranties issued by any SPF manufacturer (manufacturer responsible for any SPF defect regardless of the source of the defect).

The Alpha Program assisted the SPF contractor to identify the roof requirements before they installed the SPF roof system, which helped the contractor to preplan the project from beginning to end. From this pre-planning afforded by the Alpha Program, the contractor was able to preplan the project, mitigate the risk that is normally caused by non-expert stakeholders, and identify project cost and time deviations throughout the project (caused either by DFWU or by the client). DFWU identified the potential to install a quality SPF roof through obtaining the warranty for 15 years from the foam manufacturer, and the SPF manufacturer. In addition, the contractor also signed a 15-year contractor workmanship warranty, understanding that DFWU is required to fix any roof defects for the 15-year duration. It was the high performance of the DFWU contractor, the correct implementation of the Alpha SPF roof system, the quality control and quality assurance Alpha system and the careful documentation of the installation that minimized the risk and delivered high project performance.

DFWU additionally documented risks and deviations throughout the project using the WRR. The WRR was able to provide transparency to all stakeholders when the deviations occurred, and demonstrated its value to the client and to the contractor.

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DFWU delivered great value to DISD through the Alpha Program. The time in delivering the project was quicker, delivering the project in a total of 20 days. The cost was significantly cheaper than a traditional built-up roof, with an additional $100,000 in energy savings from the R20 value on the roof. The project received high customer satisfaction ratings as a result with both the owner giving a 10 out of 10 rating for the roof and the roof inspectors giving a 10 out of 10 roof quality rating. The roof had no punch list items. The foam's dimensional stability figures were the "best in the industry." Despite all of the events that could have caused delays in the project, the Alpha contractor, using the WRR, mitigated the risk, and delivered a high-quality roof system. This roof installation demonstrated how the contractors' increased accountability led to an increase in the contractor's performance on the job. The Alpha quality assurance and SPF roof system delivered dominant performance and demonstrated best value for DISD in terms of cost, time, and quality.

The contractor, DFWU, was the most important component to the high performance of the Alpha SPF roof installation. Both the Alpha coating manufacturer and the SPF manufacturer supported the contractor with outstanding products backed by the best warranties in the industry. The manufacturers used a quality control system (WRR) which created transparency. The third party inspection ensured the roof met the stringent Alpha requirements. The researchers propose that if this approach had been taken for all the SPF roofing installations, the DISD would have savings would be substantial.

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Appendix A: Progress Report

Task Order Weekly Update History Log			
#	**Start of Week**	**End of Week**	**Notes regarding project status this week**
1	4/4/2016	4/8/2016	PO Issued 3/31/16, Subcontract Rec 4/1/16 Returned signed 4/4/16, Rec Email Pushing Start Date to 1st week of May. Requested Drawing A206 for Scupper
2	4/11/2016	4/15/2016	Req from JOC for SOV Completed; Applied for Permit from City of Dallas on hold awaiting approval letter from Landmark Commission, notified JOC of need for copy of ltr from LC; Req & Rec P&P Bonds; Rec Scupper drwg from JOC
3	4/18/2016	4/22/2016	4/19 Rec req for additional submittals, req copy of Sec 07 5700 from JOC; 4/20 Rec email notifying ladders have been halted due to no approval form Landmark Comm., Roof hatch will remain (was to be eliminated) inspecting roof hatch for feasibility or requirement to raise. Notified that 15-year Contractor Warranty is required.
4	4/25/2016	4/29/2016	4/22 Rec notice Submittals are reviewed, Rec ltr from Landmark Comm approving roof repairs not visible, Obtained Permit, 4/28 Attended Pre-const mtg, Submitted CO 1 for permit cost, 4/29 Rec approval for CO 1. Scheduled to set materials by 4/30. Received email verifying owner's decision to leave roof hatch as is. Roof hatch to be closed upon Landmark Commission's approval for ladders expected on June 6, 2016.
5	5/2/2016	5/8/2016	Gravel removal delayed due to weather. Gravel removal started 5/4 completed 5/5. Subcontractor hired to remove sediment from inside of cap stone is too slow, Neogard approved alternate method of removal with use of primer. Subcontractor cleaning cap stone notified not to power wash on Saturday. Subcontractor still power washed area getting roof wet. A/C units were raised, curbs installed and sealed in. Scuppers on high roof were installed.
6	5/9/2016	5/15/2016	Rain majority of week. Foam application began 5/12/16, Base coat process began 5/14/16.
7	5/16/2016	5/22/2016	Work continued around weather. Rain in area in the mornings; afternoons were perfect! Evening Activities scheduled on 5/17/16 ceased work to not overspray vehicles. Rain on Wednesday 5/18. Coating application continued Thursday evening and Friday after school work ceased at 4:00 for Jazz Festival. Work to resume on Saturday and Sunday.
8	5/23/2016	5/25/2016	Completed coating process of small lower roofs and roof hatch. Touched up and cleaned area and ordered inspection both third party and DISD.
9	5/31/2016	6/3/2016	Rain majority of week. Inspections postponed until 6/7/16 for DISD and 6/8/16 for Third Party Inspection.
10	6/4/2016	6/10/2016	DISD Walk-thru completed 6/7/2016 Including DISD, Architect, Consultant, JOC Cont - First time in history ZERO punch list! Job accepted as completed. Third party inspection completed 6/8/16 - 3 core samples average compressive 60 - 6 slit samples average millage 59.

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Appendix B: Milestone Schedule

Milestone Schedule									
#	Activity	% Com-plete	Initial Schedule Start	Initial Schedule Finish	Initial Duration of Task (Days)	Actual Schedule Start	Actual Schedule Finish	Actual Duration of Task (Days)	Risk #
1	Clarification Meeting at Lipscomb	100%	3/16/2016	3/16/2016	1	3/16/2016	3/16/2016	1	
2	Notice to proceed from Architect (Review of submittals)	100%	3/16/2016	3/26/2016	11	3/16/2016	4/25/2016	41	5
3	PO Issue by DISD	100%	3/15/2016	3/15/2016	1	3/31/2016	3/31/2016	1	4
4	Moisture Study	100%	3/22/2016	3/26/2016	1	4/8/2016	4/8/2016	1	4
5	Mobilize/Set-up Safety	100%	3/16/2016	3/22/2016	7	4/14/2016	4/29/2016	16	4, 5
6	Gravel Removal	100%	4/5/2016	4/7/2016	3	5/4/2016	5/6/2016	3	4, 5
7	Foam - Including Small Lower Roofs & Roof Hatch	100%	3/31/2016	4/6/2016	7	5/12/2016	5/21/2016	10	1,5
8	Roof Hatch - Decision to Leave As Is - Decision to Eliminate	100%	5/5/2016	5/5/2016	1	5/21/2016	5/25/2016	4	2, 3,5
9	Coating - Base/Intermediates - Including Small Lower Roofs & Roof Hatch	100%	4/6/2016	4/16/2016	11	5/13/2016	5/23/2016	10	1,5,8
10	Coating - Top Coat - Including Small Lower Roofs & Roof Hatch	100%	4/16/2016	4/27/2016	12	5/21/2016	5/24/2016	3	5,8
11	Granules - Including Small Lower Roofs & Roof Hatch	100%	4/27/2016	5/3/2016	7	5/21/2016	5/24/2016	3	5,8
12	Demobilize/Punch Out	0%	5/3/2016	5/4/2016	2	5/23/2016	5/24/2016	2	5
13	Project Completion	100%	5/4/2016	5/4/2016	1	5/25/2016	5/25/2016		5
14	HVAC Units Raised/Scuppers Installed and all sealed-in on High Roof. Lower roofs added to contract will be completed on later date.	100%				5/7/2016	5/7/2016		
15	3 small lower roofs added to project by architect. Coating termination to be determined by Architect and approved by Neogard.	100%				5/21/2016	5/24/2016		
16	DISD Inspection/Walk Thru - Zero Punch List		5/31/2016	5/31/2016		6/7/2016	6/7/2016		
17	Third Party Inspection		5/31/2016	5/31/2016		6/8/2016	6/8/2016		

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Appendix C: Risks

Date Entered	Risk Items	Plan to Minimize Risk	Planned Resolution Date	Actual Date Resolved	Impact to days	Impact to Cost	Entity Responsible
3/17/2006	Subject Matter of Risk	**(1)** Problem background - Why is this a risk for the project? **(2)** What will be done to minimize this? **(3)** Who is responsible for the plan? **(4)** What kind of impact will this have?	3/17/2016	3/18/2006	0	$ -	C/V/U/O
4/11/2016	TASS Testing	1) During testing DFWU cannot operate. Work with GC, & DISD to ensure that no operations are not occurring over areas when TAAS testing is occurring. 2) Work to commence after school on test days. 3)DFWU 4) It could potentially delay the project 3 days because work needs to start after the school day.	5/1/2016		3	$0.00	Client
4/20/2016	Roof Hatch	1) Inspecting roof hatch for solution. 2)DFW can raise to code requirements, may require a change order. Ladders were halted due to non-approval from Landmark Commission. 3)DFWU 4) Architect will need to determine course of action or we cannot start. Client determined to leave roof hatch as is; to be sealed off after ladder approval from Landmark Comm 6/6/16	5/4/2016	4/29/2016	0	$0.00	Client
4/20/2016	Roof Hatch Change Order	1)Work not approved by Landmark Commission - Ladders have been halted to progress with project, roof hatch is now an issue. - DFWU needs to obtain a permit in order to start work 2) Use email to obtain permit. If roof hatch issue is not solved it could delay start date. 3)DFWU 4) If the change order is not approved for the roof hatch by 4/27, which could slow down the project start date and result in a failure to complete the project on time and will terminate the project	5/2/2016	4/29/2016	0	0	Unforeseen
4/20/2016	Non Issuance of PO	1) Delay of work due to Clients non-issuance of PO 2) Delays entire project; places project in jeopardy of delayed completion 3) DFWU 4) Delayed 30 days due to gravel removal team being unavailable	4/25/2016	4/25/2016	28	0	Unforeseen
4/20/2016	Lack of Submittal Requirements	1) Submittals: No requirements of submittals issued to Vendor - Date must be met for timely project completion. Complete submittals ASAP. 2)Notify Architect of start date and a date that submittals need to be reviewed. 3)DFWU 4) If submittals are not reviewed and accepted on time, project cannot start. If gravel removal date is missed could postpone a min of 30 days	4/25/2016	4/25/2016	0	$0	Client
5/6/2016	3 Lower Roofs	1) Architect added 3 lower roofs to scope not on original drawing. Original drawing submitted to DFW excluded these roofs. Cap stone on these roofs prevents same scope as cap stone on top roof. 2) Architect & Neogard must reach agreement on coating termination point. 3) Architect 4) Could adversely affect warranty on lower roofs and delay project completion date if not agreed upon.	5/10/2016		5		Client
5/17/2016	Evening Activities	1)Coating cannot be sprayed during school hours and activities have been scheduled for evenings without notice. 2) DFW must work around activities. 3) Client should have informed JOC cont of calendar. 4) Could delay completion.	5/20/2016		2	$0.00	Client

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Appendix D: Performance Metrics

Category	Criteria	Average
Wind Speed	Start of Day	10.0
	End of Day	6.7
Humidity Reading	Start of Day	71.3
	End of Day	61.7
Moisture Content on the Deck	Start of Day	0.5
	End of Day	0.4
Temperature on the Deck (°F)	Start of Day	94.1
	End of Day	107.8

Moisture Scan	Complete? (Y/N)	Date	SF of Roof with Moisture
	Y	4/8/2016	0

Beginning Foam Tests	Compressive Strength	Density	Dimensional Stability
	55.8	3	3.1
Existing Foam Tests	Compressive Strength	Density	Dimensional Stability
	NA	NA	NA
End Project Foam Tests	Compressive Strength	Density	Dimensional Stability
	60	3	3.1

	Wind Speed		Humidity Reading		Moisture Content on the Deck		Temperature on the Deck (°F)	
Date	Start of Day	End of Day	Start of Day	End of Day	Start of Day	End of Day	Start of Day	End of Day
5/7/2016	5-10	10-15	60	55	4	3	121	145
5/12/2016	12	10-15	68	65	2	2	121	150
5/13/2016	9	8-12	43	34	0	0	114	155
5/14/2016	12	8-12	78	41	0	0	80	117
5/16/2016	10-15	15-20	64	54	0	0	118	83
5/17/2016	8-12	15-20	73	64	0	0	76	84
5/18/2016	8-12	10-15	71	76	0	0	78	82
5/20/2016	5	5	63	48	0	0	118	129
5/21/2016	6	5	85	56	0	0	82	110
5/23/2016	12	12-15	85	80	0	0	69	82
5/24/2016	10	10	86	86	0	0	73	75
5/25/2016	14	10-15	79	81	0	0	79	82

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Appendix E: Report

Weekly Risk Report

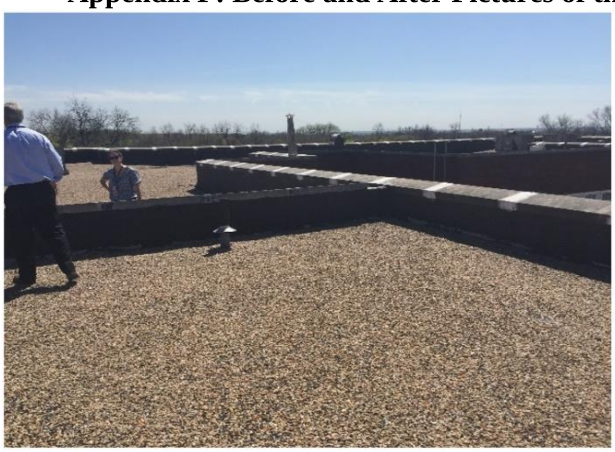
Project Title:	William Lipscomb Elementary School	**Vendor:**	DFW Urethane
Project ID / Task Order:	D009277-01	**NTP Date:**	04/25/16
Location:	5801 Worth St, Dallas, TX 75214	**Pending Risk Status:**	-
Roof Area:	16000	**Roof System:**	Alpha SPF Roof
		Warranty Completion Date:	6/8/2031

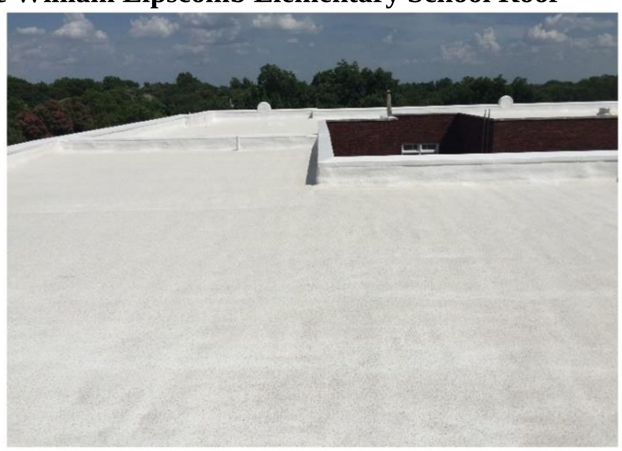
Budget	
Initial Allocated Budget	$247,764.00
Current Estimated Budget	**$247,764.00**
$ Over Budget	**$0.00**
$ Due to Client	$0.00
$ Due to Vendor	$0.00
$ Due to Unforeseen	$0.00
$ Due to Other	$0.00
% Over Budget	**0.00%**
% Due to Client	0.00%
% Due to Vendor	0.00%
% Due to Unforeseen	0.00%
% Due to Other	0.00%

Schedule	
Initial Start Date	3/16/16
Initial Completion Date	5/31/16
Current Completion Date	**5/24/16**
Days Delayed	**38**
Days to Client	10
Days to Vendor	0
Days to Unforeseen	28
Days to Other	0
% Over Schedule	**50.00%**
% Due to Client	13.16%
% Due to Vendor	0.00%
% Due to Unforeseen	36.84%
% Due to Other	0.00%

Vendor Foreseen Risk	
$ Over Budget Foreseen	$0.00
% Over Budget Foreseen	-
Days Delayed Foreseen	0
% Over Schedule Foreseen	0.00%

Appendix F: Before and After Pictures of the William Lipscomb Elementary School Roof





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Left Top Picture is part of the ledge that is underneath the flap.

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Minimize Project Risk and Costs: A New Approach to Project Management

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Traditional project management (PM) results have been poor. The practices of direction and control have been identified by deductive logic as problematic. Deductive logic identifies that, if a manager directs and controls, their risk goes up and performance will go down. A new approach to PM is the replacement of technical expertise with the identification and utilization of expertise. New components of this approach are the minimization of the need to think and make decisions, the use of the language of metrics, a new definition of risk, and the use of preplanning that includes the utilization of expertise and focusing on the mitigation of risk that the expert does not control. This approach has been tested by the International Council for Research and Innovation in Building and Construction Working Commission (CIB W117, formerly known as the Performance Based Studies Research Group at Arizona State University) for the past 25 years increasing customer satisfaction to 98% and minimizing cost by 5 to 30%. These practices are a part of the "PM of the Future."

Keywords: Best Value, Project Management, Logic, Construction, Delivery of Services.

Introduction

According to researcher publications, project management (PM) is a fundamental key component of delivering services successfully in terms of on time, on budget, with high customer satisfaction (Sears, et al., 2008; Anantatmula, 2010; PMI, 2013; Dinsmore, 2014; Rivera, 2017). The Project Management Institute (PMI) conducted a study in 2010 that identified the importance of PM across multiple industries (PMI, 2010). Ninety percent of global senior executives ranked PM methods as important to their ability to deliver successful projects and remain competitive (PMI, 2010).

PM positions have a major impact on delivering services efficiently and effectively. By observation, with the growing demand of delivering services in multiple industries, PMs will be expected to know more and have more experience to survive, making an already difficult job, more difficult (Rivera and Kashiwagi, 2016). With the continued poor performance seen in these industries, it is difficult to see how PMs who manage, direct and control the delivery of services will ensure they receive high performing and successful projects.

This research paper proposes that the current PM models are not helping in delivering high performing projects and PMs will have to use a new model to improve the performance of their projects.

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Project Managers' Delivering Poor Performing Projects

The performance of construction services has been relatively higher than other industries such as Information Technology services **(**Rivera, 2017**)**. However, studies have identified that even construction services do not have high performance. The International Council for Research and Innovation in Building and Construction Working Commission 117 (CIB W117), is a world-renowned research effort (formerly known as the Performance Based Studies Research Group at Arizona State University), headed up by retired professor Dean T. Kashiwagi, and has been conducting PM research and development for the past 25 years. In 2013, CIB W117 sanctioned a worldwide literature research study to identify its effectiveness in the construction delivery of services (Rivera, 2014, Rivera, et.al., 2016a). Relevant publications were found by viewing abstracts from one of four research databases (ASCE Library, Science Direct, Taylor and Francis Online, Emerald Insights). In total, 3,200 publications were sifted through, 260 were found to be related to the construction performance topic and were reviewed in more detail. After further review, 95 had documentation of performance in terms of rework, cost and schedule overrun, and customer satisfaction.

Table 1 shows the breakout of performance from 38 countries identified and grouped into six major regions worldwide. After analyzing the 95 construction publications, the results were documented in Table 1.

Table 1: Overall Analysis (PBSRG, 2016).

	% Projects Delay	**% Delay Amount**	**% Projects Over budget**	**% Over Budget Amount**	**Customer Satisfaction**	**Rework**
Africa	75%	53%	69%	29%	Dissatisfied	No data
Asia	68%	37%	59%	16%	Dissatisfied	No data
Europe	53%	55%	50%	29%	Dissatisfied	5%
Middle East	79%	30%	65%	15%	Dissatisfied	No data
N. America	98%	37%	98%	28%	Dissatisfied	9%
Oceania	No Data	No Data	No Data	No Data	Dissatisfied	5%

The study results identified that construction service performance in all regions and countries have delays and a significant change order rate. The struggles with construction performance is a major issue to both developing and developed countries, as construction services are required in all industries. Dr. William Badger (Professor Emeritus at Arizona State University and a Construction Industry Institute expert), identified that more infrastructure will be built in the next 30 years than the last 2,000 (CII, 2015).

In 2016, another study was sanctioned by CIB W117, to compare service performance from all industries that employ PMs. Relevant publications were found by viewing abstracts from major research databases (NASA, JSTOR, Emerald Insight, ProQuest, ASU Library, Science Direct). In total, 208 publications were sifted through, 105 were found to be related to the project management topic and were reviewed in more detail. After further review, 36 had documentation of performance in terms of cost and schedule overrun, customer satisfaction, and quality. The results (see Table 2) identified that the delivery of services in all industries researched were poor (Rivera, 2017; PBSRG, 2017). The current way PMs are delivering services is not able to deliver high performance results.

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Table 2: Performance in Industries that Employ PMs

A Few Major PM Industries	On Time	On Budget	Customer Satisfaction	Quality
Information Technology	40%	43%	4/10	Fair
Construction	25%	32%	N/A	Poor
Health Sector	N/A	N/A	6/10	Poor
Aerospace and Defense	14%	38%	N/A	N/A
Manufacturing	67%	50%	7/10	N/A
Energy	59%	59%	7/10	N/A

Research has identified that the performance issues that PMs are facing could be caused by the following factors (Ahern, et al., 2014; Elonen, et al., 2003; PBSRG, 2017):

1. Services are too complex.
2. Increased number of supply chain participants and silos.
3. Unclear roles of participants.
4. Confusion over details, which increases decision-making.
5. Misunderstood client expectations.
6. Increased misunderstandings.
7. Required to know every detail on a project.
8. Poor preplanning.
9. Project environment is non-transparent due to a lack of performance measurements.
10. Reactive environment due to client management, direction, and control.

The CIB W117 has worked with 123 clients over the past 25 years to identify the cause of poor performance in the delivery of services. The research it has performed proposes the problem might be that the current PM models create complexity on a project, causing risks to impact the performance of the service. The PM models are generated from creating and sustaining silos in service delivery. In most organizations, there are three different silos for delivering services:

1. Operational – the group that needs the service.
2. Procurement – the group that buys the service.
3. Project management – the group that manages the delivered services.

The first group attempts to identify what they need, the second group buys the service and the third group manages it. It has been observed that none of the three groups understands fully what is being done in the other silos. Logic identifies that silos create complexity, which generates confusion and misunderstandings. All three areas lack sufficient expertise and knowledge to deliver the service themselves. One attempts to identify what they want, the second group attempts to identify the best value service through competition, and the third group attempts to manage the expert who is delivering the service.

The silos are created and sustained because all three organizations have a goal to: 1) be more professional, and 2) to show they have value. This is done through the following actions:

1. Joining professional organizations that are in their area.
2. Requiring technical degrees in their area of expertise.

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3. Attempt to create technical standards that only they understand, and then create certification in those areas to show that they have value.
4. Require experience and technical education to gain the certification.

As organizations age, the following is true about their characteristics:

1. Become more bureaucratic.
2. Are more difficult to change.
3. Their silos are strengthened.
4. Forces their "certified individuals" to continually know more technical information about everything in this fast-changing environment.
5. Certified individuals take on the role of the expert and manage, direct and control (MDC) the service provider.
6. MDC creates more complexity, which leads to lower performance.

Proponents of sustaining professional silos that create complexity in service delivery include: the National Institute of Government Purchasers (NIGP), Institute of Supply Change Management (ISM), Project Management Institute (PMI), International Project Management Association (IPMA) and the International Facilities Management Association (IFMA). With the tremendous amount of documentation on how to be more professional and more valuable, the delivery of projects in all these areas have continued to suffer poor performance in their service delivery.

Proposal

A new PM model is being proposed, which was devised from the Best Value Approach (BVA) methodology. The BVA is the same methodology that developed the Performance Information Procurement System (PIPS) and the Performance Information Risk Management System (PIRMS). These systems have been continually developed over the last 25 years to help organizations overcome the complexity generated by their internal silos (see Figure 1). The two systems have had the following performance in delivering services (Rivera, 2014; PBSRG, 2017):

1. Established in 1992 and has documented performance on over 2000 projects and services delivered (construction and non-construction).
2. $6.6B of projects and services delivered with a 98% customer satisfaction and 9.0/10 client rating of process.
3. Services delivered: construction, facility maintenance, IT, professional (design), redesign of systems and organizations and supply chain applications.
4. $17.6M in research funding generated, due to the effectiveness of decreasing buyer cost of services on average by 31% (57% of the time, the highest performing expert was selected and was the lowest cost).
5. Contractors/experts could offer the client/owner 38% more value, and decreased client efforts by up to 79%.
6. 90% of all project cost and schedule deviation is caused by the owner's non-expert stakeholders.

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7. Change order rates were reduced to as low as -0.6%.
8. CIB W117 has worked with over 123 unique clients (both government and private sector) and received 12 National/International Awards.
9. A PM who identifies and utilizes expertise can increase production by 10 times.
10. 5 to 30 percent cost savings are achieved on the projects.
11. The BVA is the most licensed technology to come out of Arizona State University licenses (54).
12. It is internationally recognized through repeated testing (Canada, Netherlands, Sweden, Norway, Finland, Botswana, Malaysia, Australia, Democratic Republic of Congo, France). Education efforts are in Poland, Saudi Arabia, India, Vietnam and China.
13. Some of the largest projects documented were: $100M City of Peoria Wastewater Treatment DB project (2007); $53M Olympic Village/University of Utah Housing Project (2001); $1B Infrastructure project in Netherlands (2009).
14. Some of the highest performing projects documented include: ASU tested BVA in their business services and procurement department, resulting in $100M of revenue. Changed the entire procurement service industry in the Netherlands through the success of a $1B infrastructure test that cut procurement cost by 50% and help the project finish 25% faster. As a result, the Rijkswaterstaat won the most prestigious procurement award in the Netherlands, the 2012 Dutch Sourcing Award, and now NEVI (Dutch Professional Procurement Group) is licensing BVA technology and certifying in the Netherlands (Rijt, J., Santema, S. 2012).

The PIPS/PIRMS have been audited multiple times in the last 25 years. Two of the audits identified the impact and effectiveness of the PIPS/PIRMS systems in detail:

1. The State of Hawaii Audit (Kashiwagi et al. 2002; State of Hawaii Report 2002 (DISD)).
2. The Dutch Study on the Impact of PIPS (Duren & Doree, 2008).

These studies confirmed all performance claims of the systems were accurate. Duren and Doree's study found the following results for projects performed in the United States (Duren & Doree, 2008):

1. 93.5% of clients who worked with PIPS/PIRMS identified that their projects were delivered on time.
2. 96.7% of clients who worked with PIPS/PIRMS identified that their projects were delivered within budget.
3. 91% of the clients stated that there were no charges for extra work.
4. 93.9% of the clients awarded the supplier's performance with greater than an 8 rating (on a scale from 1-10, 10 being the highest performance rating).
5. 94% of clients would hire the same supplier again.

The other two groups that conducted audits were The Corps of Engineers (COE) PARC, 2008; 2008; and the Western States Contracting Alliance (WSCA) Agreement, 2011. No other research group has had their research test results audited (Kashiwagi, 2016; PBSRG, 2017).

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Movement toward Automation, Robotics and Information Systems

There is a movement of automation going on in our environment. Removing the human worker along with their thinking, decision making and illnesses, has increased the quality and consistency of technologies being developed. In the future, the following three areas will have value:

1. Anything that can be automated will be automated.
2. The identification and utilization of expertise.
3. Areas of expertise that cannot be automated.

The area which offers tremendous potential to project managers is the identification and utilization of expertise. In the last 25 years of research with the BVA, the ability for project managers with no technical expertise to identify and utilize expertise of expert vendors to deliver outstanding performance shows a great area of impact for project managers. The researchers propose that project managers in areas of poor performance, may increase the performance by using the BVA as a project management model.

Proposed Best Value Approach Project Management Model (BVA PM)

A project manager will be able to utilize the new BVA project management model to improve their ability to deliver services. This will have some immediate impacts on the delivery of services (see Figure 1):

1. First, it eliminates an organization's main service delivery silos (operations, procurement, project management), by bringing in and allowing the PM to lead the project from inception to completion. The PM will identify the expert, then utilize their expertise to identify the requirement and deliver the services.
2. Second, during the selection of a project, it creates a decision-less structure (BVA structure) for the PM to identify and utilize expertise.
3. Third, during a clarification phase, it shifts all accountability of project success from the PM to the expert vendor. This is done by requiring the expert delivering the service, to utilize their expertise to create transparency by seeing into the future. The expert will create a plan that clarifies the operation group's expectations, how they will accomplish the plan, all stakeholder roles, responsibilities and resource requirements, and how they will measure and report success. This will be approved by the PM prior to a contract award.
4. Fourth, during the execution phase, it minimizes the workload of the PM by replacing the PM's normal quality control responsibility with a non-technical quality assurance responsibility. The PM will collect a weekly report from the expert that identifies the current progress, performance and risk occurring on the project.

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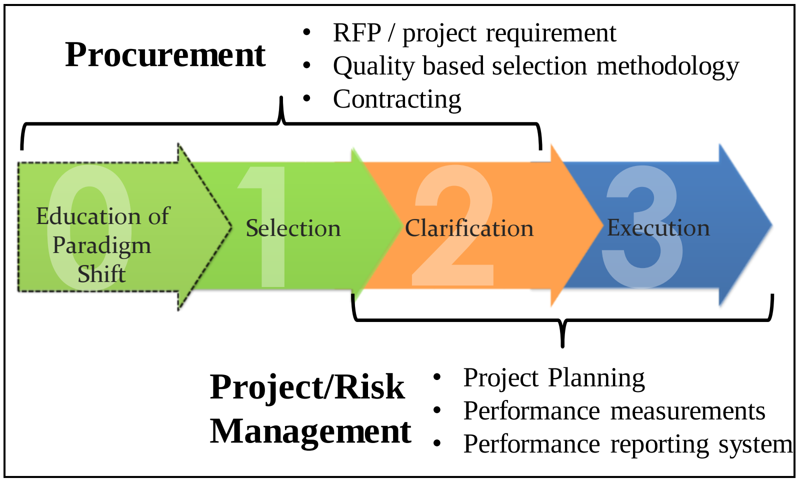

Figure 1: The Best Value Approach

This new PM model will be known as the Best Value Approach (BVA) Project Management Model (BVA PM).

What makes the implementation of the BVA PM model difficult, is that it requires the PM to lead both the procurement and PM functions (see Figure 1). It affects two different professional silos, but when implemented is more impactful (Rivera, et al., 2016b; Rivera and Kashiwagi, 2016). In the proposed new BVA PM model the PM has the following responsibilities:

1. Minimize silos.
2. Does not manage, direct or control another entity.
3. Main responsibility is to identify and utilize expertise.
4. Has the expert (hired expert) create transparency, to help all non-experts (all stakeholders interfacing with project that is not the expert) to see the future of the project.
5. Identifies the expert as one who can see from the beginning of the project to the end.
6. Identifies that an expert has no risk.
7. Identifies that risk is caused by those who cannot see into the future (non-intentional and predictable), and their risk can only be mitigated by an expert.
8. Requires that all efforts must be measured. Measurements must be simple, understandable, and non-technical. Measurements enable the PM to know the level of performance of the expert.

The BVA PM identifies that there are PMs who will be experts (service providers) and others who will not be experts (PMs who manage the service providers). The PMs who are not technical experts must be experts in identifying and utilizing expertise.

It proposes the following new definitions for the BVA PM:

1. Expert: Someone who can see from beginning to end of a project. Someone who creates minimal risk (for operational purposes an expert has no risk).
2. Risk: Caused only by non-expert stakeholders. Risk is not intentional. Risk is predictable. Risk can only be mitigated by an expert.

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Observation of the environment of the delivery of services, identifies the following:

1. Any service that can be automated, will be automated.
2. The only services that cannot be automated, are where experts are required.
3. Experts are very few.
4. Experts can identify non-experts.
5. The communication of experts to non-experts is very simple and concise.
6. Most stakeholders are non-experts.
7. Experts always deliver high performance services (high quality) for the lowest possible price.

By observation, most PMs are traditional and do not accept these new concepts, but any visionary stakeholder or PM who is reading this publication can implement these concepts as test cases. Test cases will not cause the traditional PMs and associations to be afraid of change. To be effective with implementing innovative solutions, especially organizations which are large, must always run tests that show the potential for lower costs, lowering of risk and stress, and higher performance. Most stakeholders, including PMs, are non-observant (opposite of experts), are bureaucratic and are trying to survive. The BVA PM can be termed as "disruptive" and must be treated with care.

The BVA PM will create efficiency and effectiveness. It will optimize the contribution of experts. Experts will always preplan and mitigate risk before they deliver a service.

The following sections will identify the difference between the BVA PM and traditional PM models.

Traditional PM Model vs. BVA PM Model

To clearly show the difference between the traditional project management models and the BVA PM model, another literature research was performed. This research was performed as part of a doctoral student's dissertation, from 2015-2017 (Rivera, 2017). The literature research compared the BVA PM Model practices and characteristics to the top Traditional project management models.

The research looked into many different research databases. The research first identified all PM models that had been documented in a publication. Then the research identified the PM models that had objective performance information. Objective performance information being defined as non-survey data collected on projects (e.g. cost savings, on budget/schedule, and any dominant information). Then the research compared those traditional models with objective information with the BVA PM model.

Out of the 10,503 publications searched, 800 were reviewed in more detail. Out of the 800, 572 publications were used for the research. The researcher identified 19 traditional PM models in total to investigate. Out of the 19 traditional PM models, only 10 models had objective

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information. Once identified, a more in-depth analysis was performed on them to determine the practices that the models used to improve the performance of the delivery of services.
The literature research supported the CIB W117 research group's 25 years of industry observations and documentation that the traditional project management model includes the following major three characteristics and the practices that go with each:

1. Management, Direction and Control – PM telling the expert what to do, which consists of the following PM practices:
   a. Choosing which expert should conduct a project in selection.
   b. Determining the scope, cost, and schedule of each project based upon their technical experience and understanding prior to or after the contract has been awarded.
   c. Directing the expert during the execution of the project, on how to carry out the project to completion.
   d. Directing the expert on what to do if something is perceived as not being done correctly, or unforeseen occurs on the project.

2. Technical Communication – any form of communication (verbal, written or tool) that was detailed and complex, which requires technical training/education or knowledge in a certain area to understand. This characteristic consists of the following PM practices:
   a. Expects to know all the technical details of project.
   b. Expects to discuss the technical details and detailed plan with the expert suplier.
   c. Required to make technical decisions on the project.

3. Quality Control – any inspection or verification of the quality of the experts' work, which consists of the following PM practices:
   a. Inspection of the expert's work.
   b. Explaining to the expert why a part of their work is not acceptable, did not meet the technical standard and ensure that they fix the work in a timely manner.

The BVA PM replaces MDC, technical communication and quality control with the following practices:

1. Leadership – PMs identifying and utilizing the expertise of their experts to deliver services.
   a. Use a rating system in selection that prioritizes the best value, by requiring the experts to show how their expertise, in terms of metrics from similar projects, compares with the current project needs and their ability to explain it simply.
   b. Require the best value expert (highest prioritized expert in selection) to determine the scope, cost, and schedule for the project.
   c. Require the expert to identify how they will carry out the project and what to do if something unforeseen occurs on the project.

2. Non-Technical Communication – any form of communication that is simple and easy (written, verbal, process or tool), which does not take previous education and training or knowledge in an area to understand.
   a. Require the expert to know all the technical details of the project, and have a detailed plan from beginning to end.

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    b. Require the expert submit a weekly project report that identifies at a high level the current progress, performance and risks that occurred and how they will overcome them.
    c. Require the expert to make all technical decisions on the project, and provide a simple explanation if there is any cause for concern.

3. Quality Assurance – ensure that the expert has a plan before they begin a project, and they can explain the progress and changes to the plan throughout the execution of it.
    a. Require the expert to have a quality control plan that is verifiable through metrics and can be reported on as frequently as the PM needs it.
    b. Require the expert to identify how they will fix any work that is perceived not acceptable or does not meet a technical standard, and the time and cost deviation.

The major shift from the traditional PM model to the BVA PM model is the replacement of the PMs' expertise with the expertise to identify and utilize expertise. The expert will create the project plan from beginning to end, and identify how they know it will be successful in terms of metrics acceptable to all stakeholders prior to award. It is shifting from being the expert to utilizing expertise. Table 3 identifies a high-level summary of all the major changes in practices (Rivera, 2017).

Table 3: Summary of Practices

BVA PM Model	**Traditional PM Model**
Leadership	**MDC**
Project success depends on PMs ability to utilize *expert's* knowledge.	Project success depends on PMs ability to utilize *their* knowledge.
Service providers are the subject matter experts.	PMs are the subject matter experts.
Project success depends on *expert's* technical knowledge.	Project success depends on *PM's* technical knowledge.
Non-Technical Communication	**Technical Communication**
Documentation should have no technical jargon.	Documentation uses technical jargon.
No certification required.	Requires technical certification.
PMs use *experts* to plan as far as they can see.	*PMs* plan as far as they can see.
Quality Assurance	**Quality Control**
PMs do quality assurance and ensure experts conduct quality control.	PMs inspect and verify quality of experts' work.

The success of the traditional model is based off a PM's expertise and experience, whereas the BVA PM shifts all accountability of success to the expert.

State Agency Case Study

The BVA PM was tested at an environmental State Agency. The State Agency is one of the United States' top 18 largest states, serving a population in the millions.

Over the last decade, the State Agency has had difficulties with the performance of their environmental professional services. They identified the following problems:

1. Unable to identify performance and value of service providers (environmental experts).
2. Vendors (experts) were not meeting the quality expectations of the State Agency.
3. Management requirement of the experts was too high.
4. Inability to spend all available resources.

In FY2015, the researchers were authorized by the State Agency to conduct its first test of the BVA PM in their largest department, Water Quality Department (WQD) (Rivera, 2017). This department is responsible for identifying, assessing, and cleaning up soil, groundwater, and surface water sites contaminated with hazardous substances throughout the state with support from state funds. In other words, the WQD identifies polluted underground water and cleans it up. The program also oversees privately funded cleanup efforts.

The WQD was made up of the following components:

1. 2 upper management personnel (Section and Unit manager).
2. 5 project managers (each has 15-30+ years of experience in environmental services, and holds at least a bachelors in geology, hydrology or environmental engineering. No other information was collected on the project managers).
3. Use an indefinite delivery indefinite quantity contract (IDIQ) (multi-year contract that uses multiple service providers to deliver services).
4. 26 water contaminated sites throughout the state.
5. Have another 28 sites that need to be verified for water contamination.
6. 10 service providers on the IDIQ contract.
7. $7M budget for FY2015.

FY2015 Case Study Test Results

The WQD Unit Manager identified the BVA PM as a success. Although the State Agency attempted to implement the BVA PM on their projects, traditional practices of management, direction, and control was still a factor. Despite the use of traditional practices, Table 4 identifies the following observations.

1. WQD project managers increased work capacity by 43% as a whole (calculation is ((FY15 Total cost / # of PMs) - (FY14 Total cost / # of PMs)) / (FY14 Total cost / # of PMs)). The individual hours spent by each project manager from the previous year and test year was not collected.
2. WQD received more work (98% more scope of work completed by experts) in 33% less time (more work was measured by identifying the percent change of scope of work completion from the previous year to the new year (calculation equals: similar amount of work ($5.5M vs $5.6M) and there was a 98% increase in amount of work done (50% → 99%)). 33% less time was the amount of time the experts received less to complete their work then the year before. Experts were able to start work in August the year prior, and the year of the test, they started in November).

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3. WQD project management satisfaction of the quality of work produced increased by 22% (measured by taking the percent increase of satisfaction from the previous year to the test year (calculation equals: (FY15 satisfaction rating – FY14 satisfaction rating) / FY14 satisfaction rating)).
4. Similar number of projects were conducted at similar amounts of cost.

Table 4: Overall State Agency Performance

No.	Criteria	FY2014	FY2015
1	# of WQD PMs to manage projects	7	5
2	Total # of projects	69	60
3	Total cost of projects	$5.5M	$5.6M
4	% of projects scope of work received by WQD	50%	99%
5	PM satisfaction of experts work quality	6.9/10	8.4/10

The BVA PM did the following for the State Agency WQD:

1. Identified and utilized experts to deliver services.
2. Required experts to take full control over the project and become accountable for it.
3. Required the experts to create a plan that included performance metrics to identify how they knew their projects would be considered a success.
4. Implemented a new project report that measured the schedule and cost deviations of a project on a weekly basis, to include who was the responsible party.

The BVA PM has identified the following observations:

1. Successful implementation shows that the BVA PM may be a resourceful solution for a PMs to use to manage and receive high performing services.
2. Using the leadership practice of identifying and utilizing expertise to lower cost and increase performance appears to be an impactful idea.
3. An expert may be able to identify a project's scope and cost more accurately then a PM.
4. Measurement brings transparency and minimizes decision-making.
5. The BVA PM has been identified by the State Agency as the only option proven to transform its agency's environment from a management, direction, and control to an alignment, win-win, transparency and leadership based environment.

The State Agency Water Quality Division (WQD) has continued to implement the BVA PM. The BVA PM is an advanced and theoretically sound new PM model that can transform the traditional PM model from a silo-MDC based environment to a leadership based environment.

Conclusion

A new PM model has been researched and developed over the past 25 years by the CIB W117 research group. The new PM model is called the Best Value Approach Project Management model (BVA PM). The BVA PM helps organizations eliminate the silos of service delivery which causes complexity and low performance, by bringing in the PM to lead the project from inception to completion. The PM replaces the traditional practices (MDC, technical

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communication, quality control) of delivering services with the implementation of the new BVA PM practices (leadership, non-technical communication and quality assurance).

The BVA PM's major contribution to minimizing cost and risk and increasing performance is through the replacement of the PMs' expertise with the identification and utilization of an expert service provider's expertise. It is a new paradigm shift for PMs to recognize they are not the experts. The experts are those who are performing the service, can see into the future and make it simple. The new BVA PM also lowers cost, by minimizing the actions of non-expert stakeholders. The new BVA PM has been tested in a large government agency to show high performance and client satisfaction. The researchers propose that the BVA PM is the PM model of the future to support PMs with the delivery of services. For more information, see the referenced documents.

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Improving the Current Procurement System in Saudi Arabia: A University Case Study

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Public projects in Saudi Arabia have faced performance issues. The primary procurement system used in Saudi Arabia (low-bid) does not consider the contractors' performance. A case study conducted at a university campus in northern Saudi Arabia showed low project performance. The current procurement system was analyzed and modified to utilize the concepts of the Best Value Performance Information Procurement System (BV PIPS). BV PIPS has demonstrated high levels of project performance in previous tests. A large survey was conducted of 761 classified contractors and 43 universities' representatives. Survey respondents were asked to quantify their view regarding the current procurement system, rate their level of agreement regarding Best Value principles, and rate their level of agreement with the newly proposed procurement system which integrates Best Value principles. The results of the survey show that both, clients and contractors, are dissatisfied with the current procurement system, and agree with the new procurement system. The survey also suggests that respondents agree with Best Value principles suggesting that contractors' performance should be tracked, and procurement should be conducted using both price and past performance information. The authors recommend that the newly proposed procurement model should be implemented in more projects in Saudi Arabia to further validate the Best Value system and improve the performance of projects in the country.

Keywords: performance, cost, overruns, low-bid, public construction, selection, clarification, contractor, Saudi Arabia, Best Value performance information procurement system, BV PIPS.

Introduction

The construction industry in Kingdom of Saudi Arabia (KSA) has been developing rapidly over the last 30 years. From 1990–2000, Saudi Arabia spent $234 billion in developing the country's infrastructure (Cordesman, 2002). The Saudi construction industry has been identified as the largest in the gulf countries, as Saudi spent $575 billion on construction projects from 2008–2013 (Deloitte, 2013). In 2013 alone, the Saudi Ministry of Finance allocated $48 billion for construction projects and $66 billion for 2014 (*Arab News*, 2014). In 2015, $32 billion was spent on governmental construction projects (Ministry of Finance, 2015). However, researchers over the last three decades have classified the performance of the Saudi construction industry as poor. Three studies have identified that 70% of public construction projects in Saudi Arabia experience delays (Al-Sultan, 1987; Assaf & Al-Hejji, 2006; Zain Al-Abedien, 1983). A study identified that the average delay percentages differed from the original contracts durations in Saudi Arabia by 10% to 30% (Assaf & Al-Hejji, 2006) and in another study by 39% (Elawi, Algahtany, & Kashiwagi, 2016). Furthermore, 80% of the public construction projects in Saudi Arabia faced cost overruns (Al Turkey, 2011). According to *Arab News* (2011), nonperformance in public

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construction projects in Saudi Arabia has more than $147 billion at stake. The studies showed that one of the most important factors for the delays was the low-bid procurement system.

Problem

Previous studies have proven that construction performance in Saudi Arabia is poor. The Procurement system is considered a main factor that can increase the performance of projects. Government representatives usually base decisions on price when they procure construction projects. Previous studies have shown that low-bid is considered a major cause of construction project delay in Saudi Arabia (Albogamy, Scott, & Dawood, 2013; Al-Khalil & Al-Ghafly, 1999; Alzara, Kashiwagi, Kashiwagi, & Al-Tassan, 2016; Mahamid, 2013). A case study was conducted in a university in northern Saudi Arabia, which showed delays and cost overrun issues in the university's construction projects (Alzara et al., 2016). Authors propose that increasing project performance in Saudi Arabia requires reconsidering the procurement delivery system.

Hypothesis

It is proposed that classified contractors and universities' representatives can improve their performance by implementing Best Value Performance Information Procurement System (BV PIPS) elements in Saudi Arabia.

Study Objectives

1. Identify the current satisfaction of contractors and universities with the procurement process.
2. Use the BV PIPS model concepts to identify how to increase the construction industry performance in KSA.
3. Improve the current procurement system by a proposed model based on BV PIPS for KSA.
4. Determine if contractors and universities are interested in the new procurement process improvements.
5. Identify if the proposed improvements are acceptable for classified contractors and university representatives.

Methodology

A case study of a university in northern Saudi Arabia was used to develop a procurement system to increase the construction project performance. A literature review was conducted on the procurement system and performance of construction projects in Saudi Arabia. The traditional procurement system was compared to the BV PIPS. The current procurement system in the Kingdom of Saudi Arabia (KSA) was studied at the university, and interviews were conducted on the client side, which consisted of procurement, project staff, and the director. A modified version of BV PIPS that could be implemented in Saudi Arabia was proposed. Then a survey was created to identify whether contractors are in agreement with BV PIPS principles. A second survey was given to 761 classified contractors and 43 universities' representatives, asking about

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the current model and proposed model. Survey data was evaluated using statistical analysis to show validity and reliability of the results. Based on the results of the survey, and on BV PIPS, the proposed model was created, which can be applied in Saudi Arabia.

Literature Review

Previous researchers have identified that the use of a low bid delivery method based on low price award is a main cause of time overruns in the public construction projects in Saudi Arabia (Albogamy et al., 2013; Al-Khalil & Al-Ghafly, 1999; Assaf & Al-Hejji, 2006; Mahamid, 2013). The selection of contractors based on the lowest bid was identified as the most significant factor of project delay in 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). According to Herbsman & Ellis (1992), project quality and time are not seen as being as important as the lowest bid. Project performance is affected when vendors are selected based only on the lowest price, while ignoring time and quality (Holt, Olomolaiye, & Harris, 1994). In the United Kingdom, research encouraged the conversion to a performance-based norm from selecting vendors based on a low-bid delivery system, and results showed that the bid prices were not significant (Wong, Holt, & Cooper, 2000). The problem is not the low bids, but that the system of awarding on the low bid allows unqualified contractors to receive awards. Furthermore, a study identified that, regardless of the lowest bid, the selection of qualified contractors among other bidders would have a positive impact on project performance and cost (Iyer & Jha, 2005). When contractors' selection is based only on the lowest price, unqualified contractors are encouraged to submit bids (Herbsman & Ellis, 1992). As a result, cost and time overruns in projects increase due to the rewarding of projects to unqualified contractors (Banaitiene & Banaitis, 2006; Koushki, Al-Rashid, & Kartam, 2005). The appropriate awarding to qualified contractors would increase the success rates of construction projects (Alhazmi & McCaffer, 2000; Plebankiewicz, 2009).

The selection of qualified vendors is, unfortunately, considered to be difficult in the low bid award system (Sari & El-Sayegh, 2007). Project owners face complexity in the process of making decisions in selecting qualified contractors (Hatush & Skitmore, 1997b). Similarly, in Saudi Arabia, the selection of qualified contractors in the public sector is further affected by many obstacles, such as the difficulty of decision-making because of a lack of experience, lack of capable consultants, and organizational stress of achieving the targeted projects' scheduled duration and budget (Al-Busaad, 1997). Another study identified that the selection of qualified contractors is considered a challenge for owner procurement teams, which has a direct effect on the level of satisfaction and project accomplishment (Price & Al-Otaibi, 2010). Experts in the Saudi construction industry have found that the contractor-selection method usually fails to meet clients' expectations, which causes many issues such as cost overruns, contractor failure, increasing changes, claims, and poor quality (Abu Nemeh, 2012). According to Al-Hazmi (1987), change order modifications, cost overruns, contractor insolvency, and substandard quality are caused when unqualified contractors are awarded projects based on being the lowest price.

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A study identified that bidders aim to win by submitting the lowest bid when the competition is based only on price (Cheng, 2008). The possibility that the actual costs of projects are not being represented increases if a cost-based selection of contractors is applied (Olaniran, 2015). Another study showed that a contractor who has the lowest bid usually submits an estimate that is lower than the project's actual estimated cost (Capen, Clapp, & Campbell, 1971). Consequently, selected contractors based on the lowest-price model face risks of profit loss (Chao & Liou, 2007). Where other bidders would not accept that price, the lowest bidder will commit to the accomplishment of the project (Wolfsetter, 1996). To win bidding competitions in a low-bid procurement delivery method, bidders have used several techniques. Some bidders try to discover mistakes in the bidding documents to assist them in making change orders and claims for further work (Doyle & DeStephanis, 1990). The term *predatory bidding* refers to this approach, which is used to reduce contractors' losses (Crowley & Hancher, 1995). Therefore, the actual costs are not reflected in many low-bid projects because of the continuous order changes and claims that bidders use (Bedford, 2009). This method is used by contractors to offset the losses created by submitting a lower bid (Zack, 1993).

A survey of 54 construction experts was conducted in 2015 to identify the causes of low project performance related to cost-based contractor selection. Out of 22 identified causes, the highest ranked cause was that the selected bidders reduced their profit margins. The second cause was the low level of project control and monitoring applied by many contractors. The third cause was the incompetence of selected contractors (Olaniran, 2015). Consequently, in the long term, project quality can be affected when contractors decrease their profit margins (Han, Park, Kim, Kim, & Kang, 2007).

Rather than using the low-bid price method, a new procurement method, BV PIPS, can be adapted in Saudi Arabia to improve performance of projects. BV PIPS has proven to increase performance in construction projects. In this system, expert vendors are selected based on their performance while providing the lowest verified price. The vendors provide, in a Clarification Phase, a detailed proposal that includes the delivery information through detailed preplanning and a representative milestone schedule (Kashiwagi & Kashiwagi, 2011). Alzara et al. (2016) identified the major risk factor in not finishing on time is the lack of preplanning and recognized BV PIPS as a solution for overcoming these time-overrun risk factors.

Best Value and Performance Information Procurement System (BV/PIPS)

Dr. Dean Kashiwagi created BV PIPS at Arizona State University (ASU) in 1991. BV PIPS has been proven to minimize risks in projects and increase contractors' performance by using experts (Kashiwagi, Sullivan, & Kashiwagi, 2009; Kashiwagi, Kashiwagi, Sullivan, & Kashiwagi, 2015). BV PIPS applies a special delivery environment that minimizes decision-making and the direction, management, and control of the vendor (Kashiwagi, 1991, 2010). In 2008, the International Council for Building (CIB) Working Commission W117 sanctioned a group (TG61) to perform a study using worldwide literature research to detect innovative approaches in construction that documented an increase in performance of projects (Egbu, Carey, Sullivan, & Kashiwagi, 2008). The study filtered through more than 15 million articles, reviewed more than 4,500 papers, and identified the BV PIPS as the only system that had documented an increase in construction performance on multiple tests. Performance of projects is high when expertise is

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identified and utilized, and low when the owner attempts to manage, direct and control the contractor. The Industry Structure Model in Figure 1 shows the difference between methods based on value or on price. When the method is value-based, projects show high levels of performance, and when it is based on price, the resulting performance is substandard.

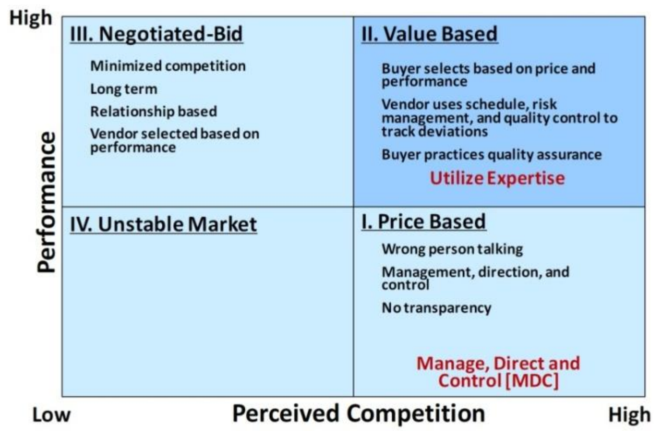

Figure 1: Industry structure model (Kashiwagi, 2014).

BV PIPS focuses on finding and using expert vendors to increase the performance of projects. The most important performance metrics of PIPS projects is when the client is satisfied. This happened 98% of the time. The projects were completed on budget, on time, and with a high level of quality. PIPS has been tested with over 1,900+ projects with $6.3 billion project value ($4 billion in construction projects and $2.3 billion in non-construction service projects). These projects' metrics show a 98% rate of success in 6 different countries and 31 states (Kashiwagi, 2014). PIPS increases project performance and efficiency while reducing project risks in comparison with the low-price bid method. The PIPS process shown in Figure 2 consists of four phases: Pre-qualification (optional), Selection, Clarification, and Execution.

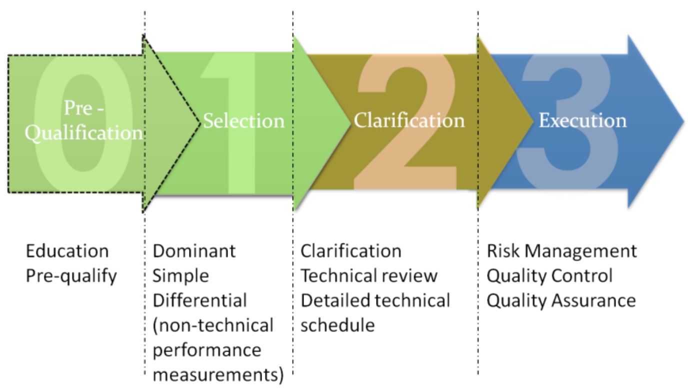

Figure 2: The four phases of BV PIPS (Kashiwagi, 2014).

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The activities of the four phases are:

1. Pre-qualification: This optional phase ensures that the contractors meet the minimum requirements and educates the contractors about BV PIPS, and how to submit dominant metrics to prove performance.
2. Selection: This phase has four filters to find the Best Value contractor for a project (see Figure 3). In filter one, contractors should submit project capability and their price, which contains three documents: level of expertise (LE), value added (VA), and risk assessment (RA). Each of the three documents should be a maximum of two pages. The second filter is an interview determining the contractors' expertise. The interview is for the key visionary experts who can see the project from beginning to the end. The third filter is the committee-prioritized criteria, which weighs the previous steps. Weighting could use numbers from 1–10 or percentages. The fourth filter is a dominance check for the most appropriate contractor who provides information to minimize risk with the lowest cost.
3. Clarification: This is the most important phase; the Best Value prioritized contractor will clarify their proposal. The Best Value contractor in this phase should explain what is outside the scope, identify a detailed project cost and time plan, a milestone schedule and a risk mitigation plan.
4. Execution: This final phase has the contractor submit a weekly risk report (WRR) to the owner. The WRR is provided as an Excel document that tracks the time and cost deviation to the milestone schedule. The WRR also provides performance measurements and a risk management plan. The Director's Report (DR) is kept by the owner and contains a summary of all project WRRs and analyses the project information to identify nonperformance and risk.

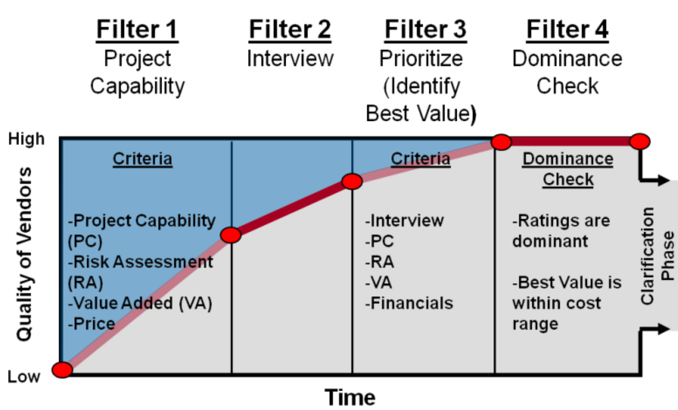

Figure 3: Shown selection phase filters (Kashiwagi, 2014).

The PIPS process has proven to be successful when applied. Table 1 demonstrates four case studies that used PIPS. These case studies indicate that 100% of the projects that applied PIPS were finished on budget, and most of the projects were accomplished on time. The table shows that there was no change in orders in all the projects, and the overall satisfaction received a high rating from project owners. PIPS considers both performance and cost in the selection of contractors, not just price (CFMA, 2006; Chan & Chan, 2004; Egan, 1998; PBSRG, 2010; Kashiwagi, 2010, 2011).

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Table 1: Examples of PIPS Case Studies.

Criteria \ Case studies	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

The case studies' results showed a high level of performance when using BV PIPS. The results showed that 100% of projects stayed on budget, and there was no change orders during implementation. The multiple phases in PIPS are used to find the expert vendor who has the highest levels of performance. The projects that used PIPS, were documented to have finished on time and received high satisfaction levels from owners and users. When vendors were selected, the Clarification Phase provided a comprehensive explanation of the vendor's scope and plan from the start of the project to its end before the projects began. Furthermore, PIPS provided transparency during the execution phase to enhance project performance by using performance measurement and risk management. Conversely, the contractors who won awards in the low-bid approach focused only on price in selecting contractors. The contractors exhibited low performance during the implementation with cost overruns and delay issues. As explained in the literature review, vendors who were awarded low-bid projects submitted low prices just to win contracts and then attempted during implementation to change the project scope through change orders to increase their profit margins.

The strategy of the low-bid method focuses only on the price criterion, whereas PIPS considers both price and performance in finding the best contractor in the selection phase. In addition, it mitigates risks that lead to cost overruns by preplanning, risk mitigation and proper estimation of the cost. The Clarification Phase is the most important phase because the selected vendor must provide a detailed project plan, cost and time schedule, and a risk management plan (RMP) that identifies all risks in the project related to stakeholders (Kashiwagi, 2011). During the execution phase, the vendor must submit a WRR to create transparency with all the stakeholders.

A University Case Study

The university campus chosen for this case study is located in northern Saudi Arabia. This campus serves nearly 26,000 students and consists of 21 colleges in addition to other facilities. The university campus required a number of construction stages to be completed. It was found that of 22 construction projects, 17 were delayed. The university campus should have been completed in 2012; however, only two buildings were operational as of 2015. In July 2015, the university campus was visited by and met with the director and the procurement and project staff to understand the current procurement system and define BV PIPS for the university.

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The current procurement system in Saudi Arabia is subject to royal decree number M/58, enacted on September 27, 2006. This system selects bidders based on the lowest price. Tenders and procurement laws include many basic principles and general provisions that consist of 81 articles. To improve the current procurement system, the fundamentals of the system must be understood. Public projects in Saudi Arabia are subjected to nine phases. The first phase involves the request for proposal (RFP). In the second phase, bids are announced in local newspapers and on Web sites. The next phase is that owners receive the proposals and check them to match instructions. Then when the committee and time are identified for opening of sealed-bids, the fourth phase is ready for financial analysis and prioritized by lowest price. In the fifth phase, all proposals should be evaluated by a technical analysis committee. Usually the lowest bidder is selected in the next phase. Then the lowest bidder moves to the negotiation phase with the owner.

In this phase, the committee negotiates the price with the vendor before they sign a contract to add or remove some orders to reach a compromised value. If the vendor and negotiating committee are not able to compromise, the committee should then negotiate with the next bidder. After they sign the contract with the vendor, they move to the next phase, which is the project awarding procedure. Then the vendor moves to the last phase, the execution phase, in which the owner hires consultants to inspect the implementation of the vendor's work. The current procurement system is shown in Figure 4.

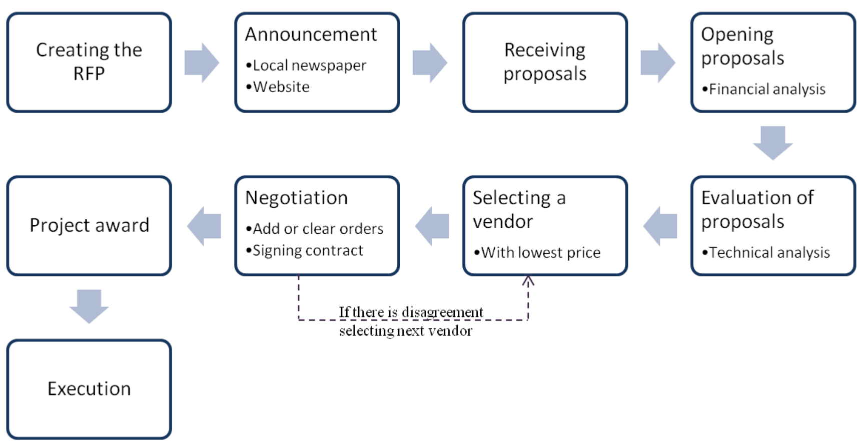

Figure 4: This shows the current procurement system in Saudi Arabia.

The purpose of this research is to alter the system shown in Figure 4 to allow for the implementation of some of the BV PIPS processes. At the conclusion of this research, the author will adjust Figure 4 accordingly. BV PIPS would introduce several key differences to this procurement process. In Saudi Arabia, the owner has the ability to ask bidders for any requirements that it wants to add to the bid. Based on BV PIPS, it is possible to ask bidders to submit some documents in the evaluation proposals phase. These documents are level of experience (LE), risk assessment (RA), and value added (VA), which help to assess the bidders' probable performance. Then, the owner can select a bidder with the lowest price and highest performance. When the selected bidder moves to the negotiation or Clarification Phase, then the PM should interview the vendor. Also, the owner can ask the vendor to submit the project's scope, technical schedule, milestone schedule, and risk management plan. In case the vendor is not qualified for these requirements, the committee should then negotiate with the next bidder. The owner then awards the project and moves to the execution phase. The vendor then submits a WRR and DR during implementation to the client, the Contractors' Classification Agency, and the National Information Center. The documented data help the owner to anticipate the vendors' performance in the future.

Survey and Statistical Analysis

When BV PIPS was discussed with the clients, surveys were created from the principles, phases, and filters of BV PIPS that could be added to the current procurement system (see Appendix A). The survey consisted of three parts: schedule delays, cost overruns causes, and the procurement system. This paper examines the results from the procurement system section. The procurement section consists of 13 questions and statements divided into three categories regarding the current procurement system, Best Value methodology, and the newly proposed procurement system that implements Best Value principles. Survey participants were asked to respond either: "Disagree," "Don't Know," or "Agree." These responses were coded 1, 5, or 10 respectively.

Surveys were sent to more than 1,500 classified contractors and 14 project departments of universities in Saudi Arabia for rating the current procurement system and to measure the interest level of applying BV PIPS in Saudi Arabia. A total of 761 classified contractors and 43 representatives of universities responded to the survey.

Reliability

The internal consistency approach for Cronbach's alpha was used to measure the statistical significance of the responses. The formula for calculating α is:

$$\alpha = \frac{n}{n-1}\left(1 - \frac{\sum_i V_i}{V_t}\right)$$ (Cronbach, 1951,

Where: n is the number of items
V_i is the variance of each question
V_t is the total variance in the category

The values of the internal consistency provided in Table 2 suggest a very meaningful reliability. Generally, a value of 0.60 or greater expresses a strong reliability so the provided values express a high degree of consistency and, consequently, good reliability. Here, also the maximum possible value that may be obtained is 1.

Table 2: Reliability Analysis Using Cronbach's Alpha for the Current Procurement Systems, BV, and the New (Proposed) Procurement Systems (n = 804).

Question Categories	Number of Questions	Dimension Alpha
Current Procurement System	2	0.806
Best Value Principles	3	0.960
New Proposed Procurement System	8	0.987
Overall	13	0.967

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Analysis

The survey results show that classified contractors and universities' representatives are not satisfied with the current (low-bid) procurement system. In addition, it shows that contractors and universities' representatives favor Best Value principles and selecting contactors based on performance information *and* price. Moreover, in the Clarification Phase, they agree on interviewing the project manager and submitting the project's scope, technical schedule, milestone schedule, and risk management plan. Figures 5, 6, 7, 8, 9, and 10 outline the survey results of classified contractors and universities' representatives' opinions regarding improving the current procurement system.

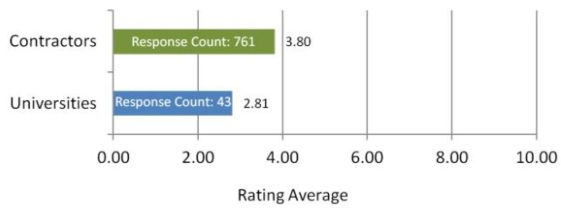

Figure 5: Satisfaction with the low-bid system.

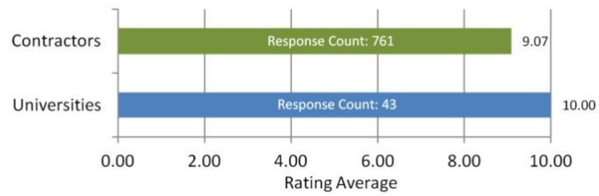

Figure 6: Agreement over selecting contactors based on performance with price.

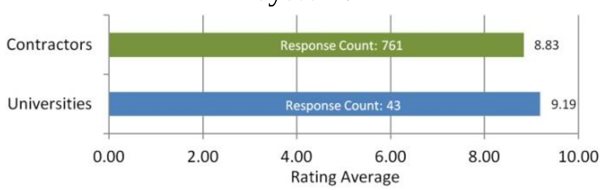

Figure 7: Agreement over whether a project manager should be interviewed during the Clarification Phase.

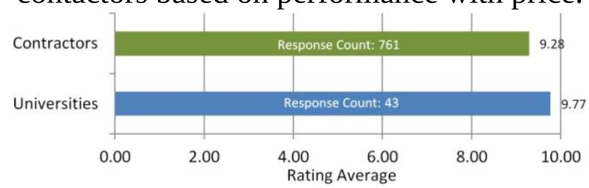

Figure 8: Agreement over submitting the project's scope, technical schedule, milestone schedule, and risk management plan during the Clarification Phase.

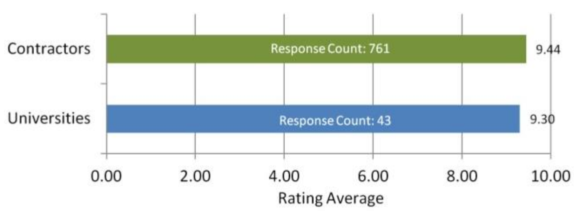

Figure 9. Agreement over documenting the contractor's performance.

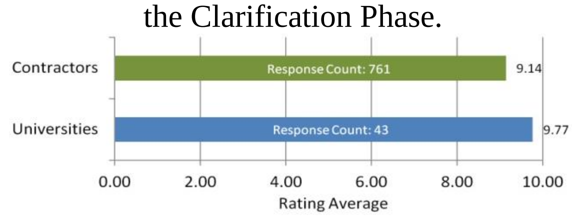

Figure 10. Agreement over whether the new procurement processes improve overall performance on projects.

The proposed procurement system using BV PIPS in Saudi Arabia utilizes the following process:

1. The first phase involves the request for proposal (RFP).
2. In the second phase, bids are announced in local newspapers and on Web sites.
3. In the third phase, owners receive the proposals and check them to match instructions.
4. When the committee and time frame are identified for the opening of sealed bids, the fourth phase is ready for financial analysis and is prioritized by lowest price.
5. In the fifth and sixth phase, the committee evaluates the level of experience (LE), risk assessment (RA), and value added (VA) documents—each of the three documents should be

two pages, maximum. Bidders with low performance should be eliminated, and the committee should select the lowest bidder price among those contractors who have acceptable performance. Committees should use the numbers 1–10 or percentages to weight the three documents and then review all documents of the selected bidder. If the committee finds anything that conflicts with the LE, RA, or VA documents, the committee should eliminate the bidder and select the next one.

6. If accepted, the lowest bidder moves to the Clarification phase with the committee. In the seventh phase, the committee should interview the project manager for 15 minutes about the project to see if the project manager is an expert. In addition, the bidder should submit the project's scope, technical schedule, milestone schedule, and risk management plan. Based on these requirements, the committee should be able to see if the bidder is an expert. If the bidder and committee are not able to find common ground, the committee should then select another bidder.
7. After signing the contract with the vendor, the vendor moves to the eighth phase, which is the project awarding procedure.
8. In the ninth phase, the vendor moves to the execution phase. Here, the vendor should submit a weekly risk report (WRR) to document the contractor's performance to the client, the Contractors' Classification Agency, and the National Information Center. These documents assist in increasing transparency among project parties, which will increase the success of the project.

The summary of the proposed procurement system using BV PIPS is shown in Figure 11.

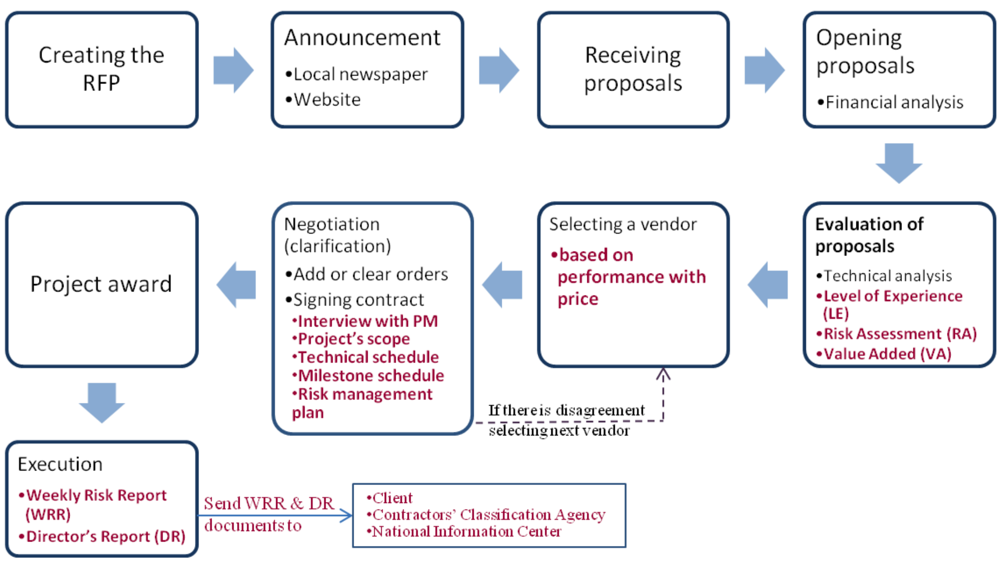

Figure 11: Proposed procurement system using BV PIPS.

Conclusion

This research is a case study of the delivery of construction services at a university in northern Saudi Arabia. The performance of the construction has been very poor (not on time and not within cost). The researchers were motivated to identify if their poor construction performance was unique to their university or was it a problem throughout the Kingdom of Saudi Arabia (KSA). This study achieved the following:

1. Identified through a literature search that the construction in Saudi Arabia delivered with the low bid approach was non-performing.
2. Designed a survey to confirm the causes of low performance in KSA construction industry.
3. Conducted the survey among 761 classified contractors and 43 university representatives that conclusively confirmed that the low bid approach was unsuccessful, and that the attributes of the BV PIPS approach should be implemented into the procurement process.
4. Designed the implementation of the BV PIPS characteristics into the existing procurement process.

The researchers recommend that this new approach be tested on the future construction projects at the new university.

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Appendix A
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	
Contactor 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.

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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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Procedures and Issues within the Contractors Classification System in Saudi Arabia

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Research has shown that construction projects in Saudi Arabia have exhibited poor performance for the past three decades. The Saudi construction environment lacks many of the best practices found in more developed countries, such as prequalification, bonding, and 3rd party insurance. The government's construction relies on the low bid delivery method and prequalified contractors using the Contractors' Classification System (CCS). However, the current CCS does not accurately represent contractors' capabilities and performance. This paper reviews all of the parts of the Saudi CCS, including the workflow and the evaluation criteria. This paper proposes to analyze the current classification system and identify the issues incorporated in the CCS regulations and classification process. This paper summarizes the authors' critical review through interviews that have been carried out with key persons in the CCS. Several issues with the CCS are identified, such as no performance feedback, complexity of the system, and high resource requirements. The findings identify that the current CCS must be modified to be able to accurately reflect contractor capability and performance.

Keywords: Saudi's Contractors classification, Saudi's construction, MOMRA, Contractors' performance.

Introduction

Saudi Arabia is one of the strongest economies in the Middle East where oil is considered one of the most important economic resources. Over the past 30 years, the Kingdom of Saudi Arabia (KSA) has seen a considerable growth of the construction industry and a major increase in large-scale projects. With investments growing in the construction sector in Saudi Arabia, between 2008 and 2014, to total approximately $574.7 billion [1]. However, several studies by construction researchers have shown that the construction industry in Saudi Arabia is suffering from poor performance (e.g. causing the delay of projects and significant financial losses). Time overruns is thought to be amongst the most continuous and difficult issues in development ventures (and their completion) in the KSA. According to Zain Al-Abedien, it was found that delays were the standard for 70% of the projects taken up by the Ministry of Housing and Public Works (1983) [2]. Six years later Al-Sultan reported the same rate (1989) [3]. He reported that 70% of Saudi Arabia's public projects had time delay issues. Al-Khalil and Al-Ghafly found the normal schedule delay in the public projects in Saudi Arabia is 58% longer than originally proposed (1999) [4]. Al-Ghafly studied the contractual workers and the specialists and found that the temporary workers believed that 37% of the tasks experienced deviations (1995) [5]. In 2006, it was found in Eastern Province that 70% of projects experienced projects delays and the normal

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delay in projects is between 10% and 30% [6]. A study directed by Al Turkey that 80% of projects were liable to negatively impact budgets, while 97% experienced time issues [7].

Saudi government relies on the low-bid delivery method and the Contractors' Classification System (CCS) as the basis for prequalifying contractors for most of the public agencies work to ensure contractors' capabilities and performance [8]. According to the Ministry of Municipal and Rural Affairs (MOMRA) website (2016), the Contractors' Classification System was originally established in 1973. The CCS was administrated by the Contractors Classification Committee. Following administration by the Contractors Classification Committee, the Ministry of Housing and Public Works took over the responsibility from 1979 to 2004. In 2004, the administration of the CCS was taken over by MOMRA. There are 4,113 classified contractors in 5 grades across 29 disciplines. In the past 3 years, 884 certificates have been issued per year (registration, renewal or upgrade in grade status).

The current classification system operates within 29 fields and 5 grades. The function of the classification grades is to determine if a contractor is classified in a certain field. Through grades 1-5, the contractor will be limited to a certain maximum financial value of a project and a contractor can carry out the project in his specific field. If a project does not exceed its upper limit, the contractor is not required to have a grade. An example of some of these fields and financial limits are given as follows in Table 1 [9].

Table 1: Example of fields and financial limits (in Millions of Saudi Riyals).

Field	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	No Grade
Buildings	>280	280	70	21	7	4.2
Roads	>420	420	140	42	14	4.2
Water and sanitation work	>420	420	140	42	14	4.2
Electrical Works	>280	280	70	21	7	4.2
Building Maintenance	>140	140	42	14	4.2	1.4

From the literature, researchers have studied the Saudi contactors' classification system. Alsugair and AbuThnain in 2011 conducted a questionnaire to assess the Government Contractor Classification System in Saudi Arabia [10]. The main conclusion of this study was that the current classification system does not properly reflect the contractors' capabilities. However, the study has not been able to determine the reasons of this issue. Mahamid in 2014 conducted a research study to identify the common direct and indirect (micro and macro level) dispute causes in residential building projects in Saudi Arabia [11]. This study refers that the Contractor Classification System in Saudi Arabia is one of the highly relevant causes to construction problems that lead to dispute between construction parties. In 2012, Riyadh Chamber of Commerce conducted a study of the difficulties facing the construction sector, the study found that the system and procedures of the contractors' classification system is the most important and influential factor [12].

Problem

The Saudi construction industry has had poor performance for the last 3 decades because of contractors' low performance. The contractors' classification system (CCS) is the only system

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used in most of the public agencies in Saudi that prequalifies contractors to ensure their capability and performance. The contractors' classification system is facing difficulties in accurately reflecting the contractors' capabilities and performance. According to the literature, it shows there are a very few studies that discuss and evaluate the CCS. The reasons behind these difficulties have not yet been identified in previous research.

Proposal

Current literature suggests that CCS is inefficient. However, no credible research has conducted an in-depth investigation of the issues of the current classification of workflow, evaluation criteria, regulations and process. This paper proposes to research the CCS and identify the issues incorporated in the CCS regulations and classification process.

Methodology

The methodology in this research starts by reviewing and analyzing the current CCS process including the workflow and evaluation criteria. The authors will identify the main issues in the system by conducting interviews with MOMRA. The authors interviewed the strategic plan team in MOMRA and key persons in the CCS in several meetings starting from October 2015. In total, 10 officials were selected and interviewed based on their experience in the CCS system (average 15 years) and their positions in MOMRA and CCS agency (general, legal, technical, services directors, and consultants who work with the agency). Interviews were conducted face to face and the objective of the open-ended questions was to evaluate the current CCS process and identify the root causes of the incorporated issues.

In order to answer the main question of the study, "Why doesn't the current CCS accurately evaluate and reflect contractor performance and capability?" face-to-face panel interviews were scheduled with the 10 chosen members of MOMRA. The following questions were asked:

1. Could you describe the flow of the current CCS structure?
2. What are the evaluation criteria of contractors' capabilities?
3. What are the main issues in the CCS system?
    a. What are the internal issues in the CCS system?
    b. What are the external issues to the CCS system?
4. Does MOMRA have any strategic plan to improve the CCS system?

Results

In the interviews, the authors asked the interviewees to describe how the current CCS worked. The collected information shows that contractors bid on projects that have been assigned grades based on project budget, and the CCS plays the role of assigning contractors the maximum grade of projects they can bid on. MOMRA manages the CCS, and contractors are assigned a maximum grade through certifications that expire after 4 years. Interviewees explained that

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contractors could apply for any project-grade certification regardless their current certification status. MOMRA reviews the contractor's application and determines whether the contractor can receive their requested certification through an evaluation process. Contractors apply by first filling out classification forms based on the requested certification grade. MOMRA then performs an evaluation based on legal, technical, and financial criteria. After MOMRA performs the evaluation, MOMRA informs the contractor if their application is accepted or denied. If accepted, the contractor is then certified to bid on projects for 4 years without additional evaluation until the certification expires. After the certification expires, the contractor must renew his classification. The contractor may choose to apply for a higher-grade certification, in which the application and evaluation process must be repeated (See Figure 1).

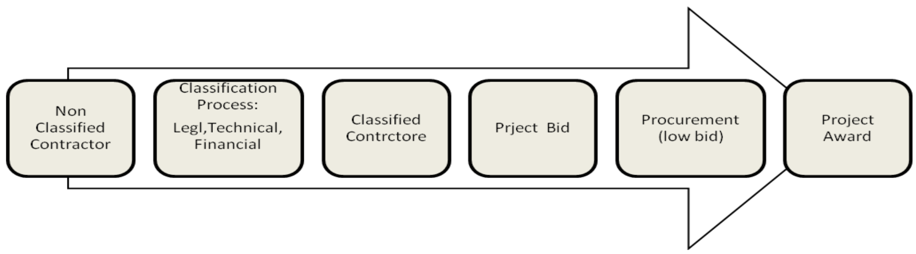

Figure 1: Contractor Classification System Structure

The main requirements in the legal analysis include items such as the address of contractor's main office (Saudi contractor and non-Saudi), client endorsement, names of the owners of the company, partners or major shareholders (with their nationality), the proportion of capital into the company, the field of grade classification being sought and commercial register. In order to receive this information, MOMRA has created forms that all contractors must complete and submit to be eligible for classification. There are a total of 10 general forms to be filled out by the contractor, 4 forms filled out by MOMRA employees, and 1 form filled out by the contractor's clients. If the contractor passes the legal analysis, then they will proceed to technical and financial.

The technical criterion contains 5 major elements including: the client's survey of the contractor, equipment, a site visit, personnel involved, and project details. The personnel element includes managers, engineers, technicians, and specialists. The project element includes project value, monthly value, yearly load, high value project, and continuity. The total estimated weight in classification rating for the technical criteria is 70% (table 2).

The financial analysis contains three major elements including balance sheet, profit/loss, and financial ratios. The balance sheet includes total assets, net worth, and working capital. The profit/loss includes total revenue, net income, net cash and income. The financial ratios include liquidity, profitability, leverage and efficiency. The total estimated weight in classification rating for the financial criteria is 30% (table 3).

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Table 2: Classification Rating of Technical Analyst

Criteria	*Clients' Certificates*	*Personnel* • Managers • Engineers • Technicians and Specialists	*Visits* • Head Office Visit • Site Visits	*Projects* • Project Value • Monthly Load • Yearly Load • High Value Projects • Continuity	*Equipment*
Weight	10%	8%	10%	30%	12%

Table 3: Classification Rating of Financial Analyst

Criteria	*Balance Sheet* • Total Assets • Net Worth • Working Capital	*Profit & Loss* • Total Revenue • Contracting • Revenue • Net Income • Net Cash • Income	*Financial Ratios* • Liquidity • Profitability • Leverage • Efficiency
Weight	9%	13%	8%

After the interviewees described the current CCS, the authors then requested feedback on potential issues within the system. Among the main criticisms of the CCS is that it does not accurately prequalify contractors. Interviewees expressed multiple frustrations and described contractor behavioral issues due to the CCS. The interviewees explained certification is only important to contractors every 4 years since there is no contractor regulation within the 4-year period.

The interviewees then described internal system issues, which were broken down into two categories: system philosophy and evaluation process.

System philosophy issues:

1. The traditional approach of the CCS System includes attempts to collect and utilize technical information from contractors to predict future contractor performance over the course of 4 years.
2. Once a contractor is classified, it can be assumed that they can perform projects in their classification grade and field for 4 years. However, this assumption may not be valid as the 4 years period is too long in which the contractor's level of performance and capability may change due to many reasons such as projects overload or financial issues.
3. The CCS agency employs technical experts to make decisions on the technical information obtained from the contractors to predict future. These decisions are considered subjective and are not related to the actual contractors' capability or performance.
4. The CCS only required contractors to turn in information once every 4 years; the contractors are not tracking and providing their performance (cost and time deviation or doing risk mitigation) to MOMRA which results in MOMRA not being able to analyze the actual performance of the contractors, the industry and the CCS.

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Evaluation process issues:

1. Due to the large quantity of technical information required, there is an increase in the complexity of the system (e.g. increased subjective decision making, decreased transparency and increased need for more technical information to attempt to mitigate risk).
2. The complexity of the system creates confusion for both agencies and contractors involved in the CCS process. The confusion creates complaints and increased effort from CCS stakeholders.
3. Site visits are only an assessment of one project. The main office visit aims to verify the contractors financial, technical, and administrative information provided in the forms with records and documents calculations for the contractor and evaluation. This is also the verification of engineers and technicians employed by the contractor. The method of performing office visits is aimed to provide an audit of the applicant contractor; however, a large quantity of information is required to be checked in a single short visit. In addition, contractors sometimes delay the site visit, which has a negative effect on the process of the classification.
4. The visit is considered very costly to the CCS organization and proven to be non-sustainable. Site and office visits annually take 31.8 % of the MOMRA employees' workload and 11.9% of the agency expenses. In addition, the visits may not be an effective control measure.
5. The financial analysis consists of 11 criteria and most of the financial criteria consist of repeated information and are too complex for the contactor to understand.

After explaining the issues within the current CCS, interviewees described issues external to the system that affected contractor performance. These issues are not currently included in the evaluation process. Saudi Arabia has no mature bonding program, no effective third party insurance system that covers workers compensation, no building, health, or safety insurance, and no regulatory Occupational Safety and Health Agency (OSHA) organization. The KSA has no mature prequalification system that uses financial organizations such as Dunn and Bradstreet (D&B) that gives a benchmark check of a contractor's financial stability. The licensing bureau in Saudi Arabia is not a regulatory entity that can affect a contractor's classification rating. In addition, there is no integrating system in Saudi Arabia to utilize the risk mitigation capability of timely and accurate classified contractor performance information. MOMRA has the responsibility to mitigate the construction risk through its contractor classification system (CCS).

The authors then asked the interviewees if MOMRA had any strategic objectives for improving the CCS. The interview results suggest that MOMRA's strategic plan seeks to simplify and minimize the subjectivity of the CCS, motivate contractors to participate in the CCS, and improve performance. Additionally, MOMRA's plan states that they want to develop, support, and improve the construction sector performance by creating a state of the art knowledge and information system.

Conclusion

This paper examines the results of interviews structured to examine the Saudi CCS, including the workflow and the evaluation criteria. Several issues incorporated in the CCS regulations and

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classification processes have been identified. The main issue in the CCS system philosophy is that there is no contractor regulation within the 4-year classification period. Contractors are not tracking and providing their performance to MOMRA resulting in MOMRA not being able to analyze the actual performance of the contractors. The 4-year period is considered too long as the contractors' level of performance and capability may change drastically in 4 years due to several potential reasons such as, employees' expertise, projects overload or financial issues.

The underlying issue of the evaluation process is that it requires a large amount of technical information from the contractors. This requirement increases the complexity of the evaluation, increases subjective decision-making, and decreases transparency by making it difficult for multiple parties to clearly understand. Many parties consider the evaluation process to be highly inefficient because it is too costly and time consuming. In addition, the financial analysis criteria are repetitive and too complex for the contactor to understand. Finally, the CCS does not adhere to proven standers procedures in contractor evaluations such as prequalification, bonding, and 3rd party insurance in the Saudi construction environment made the situation more difficult on CCS. It is recommended that the current CCS should be re-evaluated and revised to accurately reflect contractor capability and performance.

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