CASE STUDY OF THE DALLAS INDEPENDENT SCHOOL DISTRICT'S CONSTRUCTION VALUE

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The objective of this research is to show that proper outsourcing may result in an increase of roofing system performance (on time, on budget, and meeting the user's quality expectations). The Dallas Independent School District is attempting to increase roofing construction performance by using a best-value system called the Performance Information Procurement System. The District had the following sub-objectives: 1) increase competition, 2) increase the level of service of contractors/manufacturers, 3) minimize management and inspection requirements, 4) increase the quality and performance of roofing construction, 5) increase the warranty period and improve the response to warranty issues, and 6) increase the overall value of roofing construction by offering longer service periods with lower maintenance costs. The PIPS roofing tests met all of the DISD objectives.

Keywords: best value, outsourcing, performance-based procurement.

INTRODUCTION

The Dallas Independent School District (DISD) has experienced construction problems in the past (Rylander 2001, Houston 1997). A new superintendent was hired to improve the DISD's management of the school district and to improve the value of procured construction. In 2002, DISD tested the Performance Information Procurement System (PIPS), an information-based best-value procurement system. The test was applied to the procurement of roofing systems to determine whether the process could improve performance. Problems encountered in the DISD roofing program included poor contractor performance, lack of manufacturer warranty support, and an inability to attract sufficient quality bidders (Cekosky 2002, Smith 2002). These results were not unique to DISD's roofing program (Patterson 1996). Construction performance (on-time, on-budget with no contractor generated cost change orders, and high construction performance) has not been a characteristic of the construction industry (Butler 2002).

The Performance Based Studies Research Group (PBSRG) proposed to DISD that the lack of performance was caused by industry instability. The hypothesis was that by creating an environment that stabilized the construction environment, construction performance would increase.

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CONSTRUCTION INDUSTRY STABILITY

The construction industry structural model (CIS) (Figure 1) (Kashiwagi 2002) identifies the differences between information-based outsourcing processes and the low-bid award (design-bid-build) process.

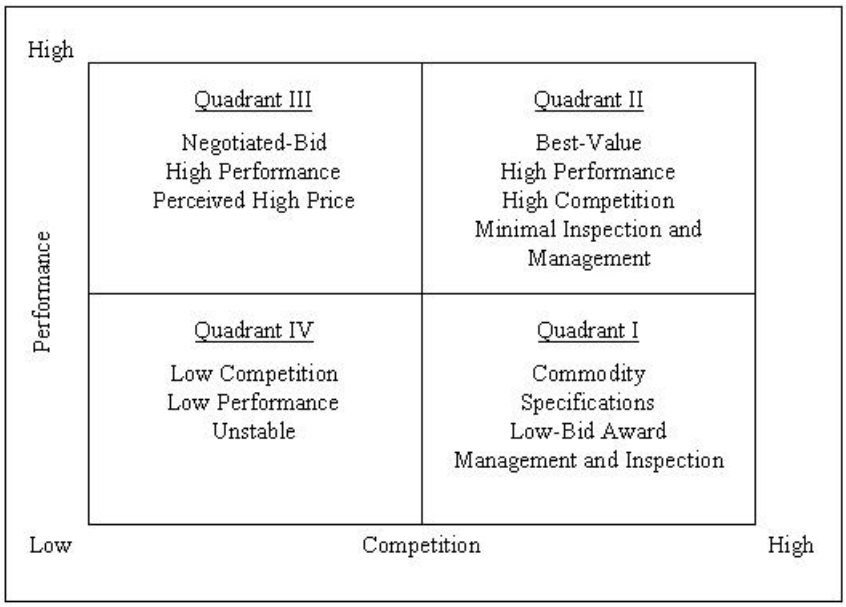

Figure 1: Construction Industry Stability

In Quadrant I, the designer attempts to deliver construction as a commodity, using minimum requirements to describe the commodity. The designer controls the process by selecting materials and means and methods. The result of making a subjective decision based on limited personal experience is the minimization of competition. The designer decides who and what systems meet the minimum design requirements. The project is commonly awarded to the lowest bidder, and the designer controls the construction performance through management and inspection. There are several problems with this philosophy. First, the project is awarded to the lowest cost proposal, sending a message to the contractors that the contractor with the lowest possible price and acceptable quality is awarded the project. This motivates contractors to shift their current level of performance to the lowest possible level while still meeting the minimum requirements (Figure 2). Secondly, since the contractor's goal is to make a profit, the contractor is motivated to lower their quality (quality costs money), creating an adversarial relationship between the contractor and the owner (Figure 3).

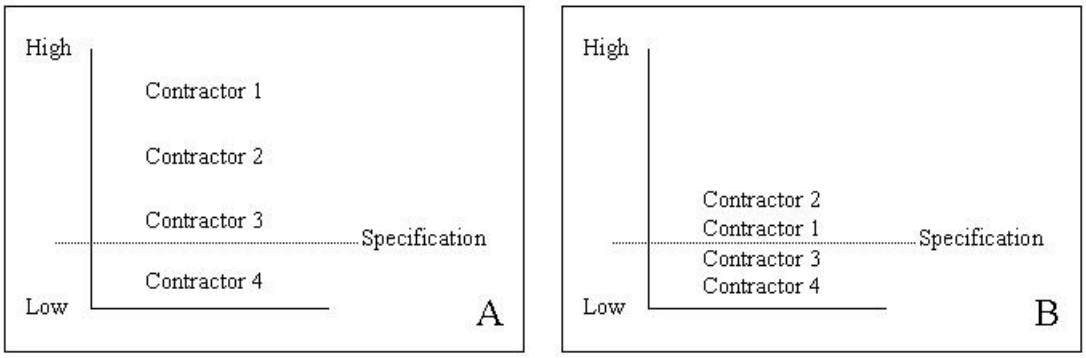

Figure 2: Impact of Minimum Standards on Performance

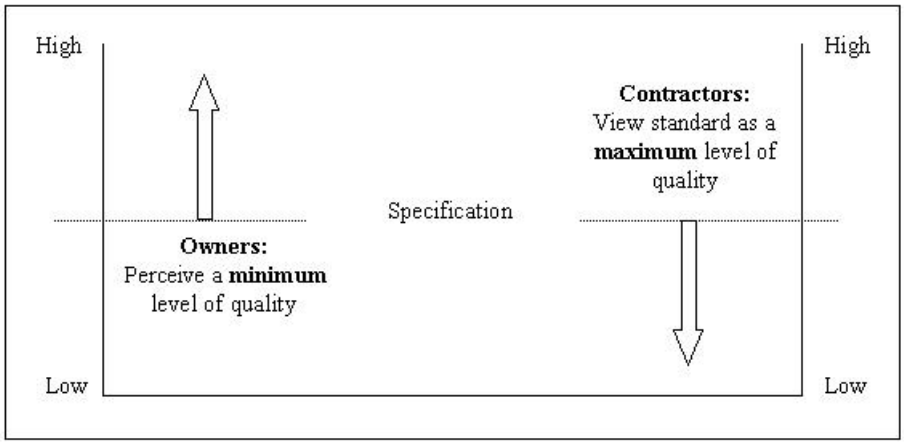

Figure 3: Owners vs. Contractors: Difference in Objectives

The owner has not been able to achieve high performance in the low-bid environment (Figure 1, Quadrant I). Quadrant II (Figure 1) is a high competition, high performance environment. This is the best-value quadrant in which users consider both performance and price (optimal price for performance). The best-value quadrant differs from the other quadrants because the owner:

1. Compares price and performance to identify value.
2. Uses performance information.
3. Maximizes competition by minimizing minimum standards and subjective decision-making.
4. Allows the contractor to accept and minimize risk. This shifts the risk to the contractor and minimizes the owner's need to trust the contractor.
5. Minimizes the need to manage and control the contractor.
6. Allows the performing contractor to control the construction project.
7. Forces continuous improvement by continually recording and using tracking the contractor's performance.

PERFORMANCE INFORMATION PROCUREMENT SYSTEM (PIPS)

PIPS was designed in 1991 and first tested in 1994 (Kashiwagi 1997). Since then, this information-based procurement system has been tested 350 times on $170M of construction. Once the request for proposal has been developed, the PIPS process involves the following five major steps:

1. Past performance is collected on the contractors and manufacturers.
2. Contractors identify and minimize the owner's risk in terms of funding, time, and quality.
3. Bidders are prioritized using an artificial intelligence processor that considers price and performance.
4. The best-valued contractor clarifies all construction issues, minimizes all identified risks, and coordinates the project during a pre-award period.
5. A post project rating is used to evaluate the contractor's performance once the project is completed.

OBJECTIVES OF IMPLEMENTING PIPS

DISD moved from a Quadrant I to Quadrant II environment by implementing PIPS. Hypothetically, this move would create higher performance, more competition, and better value. DISD set the following objectives to validate this hypothesis:

1. Increase contractor and manufacturer participation.
2. Complete the projects on time and within budget, without generating any contractor change orders.
3. Minimize the DISD's required roof maintenance.
4. Shift the risk of non-performance from DISD to the roofing contractors.
5. Provide longer and/or better warranties.
6. Provide justified documentation on using best-value procurement to select a contractor and a system.

IMPLEMENTATION

DISD implemented PIPS on nine different roofing projects. The scope of the work involved re-roofing nine school buildings. The following challenges were identified in the implementation:

1. The procurement officer had difficulty understanding the Quadrant II environment.
2. To implement PIPS, DISD's legal procurement requirements forced the modification from a one-step to a two-step (prequalification and final selection) process.

The first phase included:

1. Collection of past performance information for contractors and manufacturers. Both were requested to submit a maximum of 40 references. Performance data was collected from these references. This included customer satisfaction questions rating the contractor's level of honesty, ability to waterproof, overall performance ratings, roof service periods, and the status of roof leaks.
2. DISD inspected approximately 20% of the roofs used as references. Physical characteristics, which showed performance on criteria such as the number of roof penetrations, ponded areas, and deteriorated areas, were annotated and used in the prioritization.
3. The contractors submitted a prequalification package that included the legal requirements of DISD, a management plan that identified and minimized risk, a roof warranty, and a proposed construction schedule.

4. The management plan was rated using a relative rating of 1 to 10, 10 being the best.
5. The artificial intelligence model (DIM) (Zeleny 1984) was used to prioritize the contractors based on performance, which included past performance and the ability to minimize risk.
6. The top five contractors moved into the second phase.

The second phase included the following steps:

1. Contractors were asked to provide additional details on their proposals and submit a comprehensive management plan that included a cost estimate. They were also asked to submit Minority, Women, Business Enterprise (MWBE) documentation.
2. The contractors were prioritized by the model based on a performance-to-price ratio of 50%/50%. The performance factor included:
    a. Contractor past performance (33%).
    b. Manufacturer past performance (33%).
    c. First phase management plan rating, second phase management plan rating, and MWBE rating (11%).
    d. Warranty value (11%).
    e. Construction time (11%).
    f. The selection of the best value was made based on risk minimization rules.
3. The contractors were brought in to clarify any construction problems and accept the project.
4. The award was made, construction completed, and the contractors were rated.

DISD further minimized the risk of nonperformance by instituting the following rules:

1. The DISD limited the number of roofs a contractor could receive to 33% of the roofs (by roof area). This ensured that one contractor would not get a majority of the roofs (DISD concerns: if a contractor is awarded the majority of the projects and the possibility of the same contractor unable to finish the work in a timely manner).
2. DISD limited the number of roofs a system could be award to (DISD choose not to award a system more than 66% of the total roof area). This would deliver at least two performing roof systems to DISD, allowing them to compare the value of having different roof systems.
3. The roofs were awarded if one of the top three contractors was within budget and met the above requirements.
4. DISD held the right to modify the policies in the best interest of DISD.

RESULTS AND ANALYSIS

PIPS' immediate impact was contractor service on existing DISD roof problems (Smith 2002). Applying performance information resulted in roofing contractors and manufacturers servicing previous roof installations for DISD, which had been

requested by DISD but ignored by the roofing manufacturers. The DISD maintenance supervisor noted that all contractors wanted to fix existing roofing problems. The use of performance information increased the level of service even before the project roofs were bid. This result corresponds to the results in the State of Hawaii and demonstrates that when performance information is applied, contractors respond, sometimes beyond the interpreted legal requirements of the warranty. Contractors and manufacturers realize that their past performance was going to have an impact on their capability to acquire future projects. The PIPS process increased the level of competition by attracting more manufacturers and contractors and by minimizing minimum standards. The PIPS process attracted eleven manufacturers (an increase from three in the low-bid process) and twenty-one contractors (an increase from the three that usually bid). DISD had only one minimum requirement: the systems had to be the type that DISD could maintain (a built-up roof (BUR), modified bitumen (MB), or a sprayed polyurethane foam (SPF) system). There were no other minimum requirements (previously, BUR was the only specified system). The first phase (pre-qualification phase) considered the past performance of contractors and manufacturers and their ability to identify and minimize risk. The process pre-qualified six contractors from the combined group of thirty-two (three installing SPF and three installing BUR). Although the companies were allowed to submit a maximum of 40 references, the number of references submitted was only ten of their best jobs. The selection of only their best references supported and demonstrated their potential performance. However, twenty-two percent of the vendors submitted references that were unsatisfied. One manufacturer did not receive any of their requested references, penalizing the contractors working with that manufacturer. These preliminary results reinforce the following:

1. Contractors and manufacturers are not identifying their roof performance.
2. Contractors and manufacturers are not inspecting their previously installed roof systems or keeping in touch with the roof owners.
3. Performance, such as proven service periods, non-leaking roofs, and ease of maintenance, is not a requirement in procuring a roof in the design-bid-build arena.

Table 1 illustrates the award results of the DISD best-value implementation based on value and the additional risk minimization policies. For instance, the results indicate that Contractor 17 received the award for the Edison project (first roof), which was a very large roof. Contractor 17 is also the top rated contractor associated with the Carver project (second roof). However, Contractor 17 cannot receive more than 33% of the total roof area according to the award rules. Therefore, Contractor 10, the next highest prioritized contractor, received the project.

Further observations indicate that Contractor 6 (two roofs) and Contractor 27 (one roof) were new bidders to DISD due to the performance-based concepts that DISD was using. Both roofers could not compete in the low-bid environment, substantiating that the process resulted in a higher profit margin for these contractors; otherwise, they would not have participated.

Contractor 17, a long-time contractor who some perceived as a low bidding contractor, received two awards, including the largest roof. Contractor 17 had been known as a low performing contractor who did not work in the best interest of the owner. However, under the PIPS environment, Contractor 17 impressed the DISD personnel with their cooperation and high performance. This identifies that the

Table 1: Award Results of the DISD Best-Value Implementation

School	1st	2nd	3rd	4th	5th	6th	Budget
Edison	CONT 17 $ 875,818	CONT 10 $ 1,084,712	CONT 27 $ 1,133,200	CONT 30 $ 1,017,998	CONT 32 $ 1,835,664		$ 1,153,634
Carver	CONT 17 $ 474,418	CONT 10 $ 428,540	CONT 27 $ 541,300	CONT 30 $ 545,820	CONT 32 $ 461,415	CONT 29 $ 560,000	$ 548,347
Madison	CONT 17 $ 575,799	CONT 10 $ 703,571	CONT 27 $ 589,300	CONT 30 $ 673,276	CONT 32 $ 936,517		$ 587,336
Johnston	CONT 6 $ 447,000	CONT 10 $ 654,378	CONT 17 $ 509,719	CONT 27 $ 635,000	CONT 30 $ 580,846	CONT 32 $ 790,663	$ 716,928
Donald	CONT 10 $ 187,054	CONT 17 $ 155,694	CONT 6 $ 178,000	CONT 30 $ 186,498	CONT 27 $ 244,700	CONT 32 $ 281,746	$ 175,576
Long	CONT 17 $ 425,281	CONT 10 $ 529,801	CONT 27 $ 501,500	CONT 30 $ 512,752	CONT 32 $ 875,750		$ 437,080
Foster	CONT 10 $ 352,770	CONT 17 $ 328,086	CONT 6 $ 368,500	CONT 30 $ 388,502	CONT 27 $ 595,900	CONT 32 $ 608,617	$ 434,444
Auburn	CONT 10 $ 406,531	CONT 17 $ 365,981	CONT 6 $ 533,000	CONT 30 $ 420,989	CONT 27 $ 487,700		$ 434,120
Macon	CONT 10 $ 366,445	CONT 17 $ 295,739	CONT 6 $ 334,200	CONT 27 $ 397,600	CONT 30 $ 353,588	CONT 32 $ 373,174	$ 336,892

**Shaded cells represent awarded contractor.*

previous construction environment, and not the contractor, could have been the major reason for nonperformance. This validates the hypothesis of the Construction Industry Structure model (Figure 1).

Contractors 30, 32, and 29 did not receive any awards. These awards show that different contractors proposed different solutions for each roof, and price was not always the determining factor. Different systems with different material costs competed against each other, forcing the awarded solution to be the highest value offered for each system. In other words, contractors with a specific roofing system had to compete against each other and then with the best of the contractors installing the other roofing systems. The results yielded:

1. Comparable price: DISD awarded all roofs for 15% under budget (based upon previous low-bid awards).
2. High quality solutions were proposed, which were supported by past performance. All bids included the treatment of the roof as well as the treatment of surrounding fascia, parapets, walls, penetrations, and windows (unless directed by DISD to disregard). All bids also included waterproofing the buildings, which entailed coordination with the schools and minimizing any problems that occurred during the reroofing.

During the roofing construction, the project engineer, roofing consultant, and roofing maintenance manager recognized the following:

1. Roofing contractors met with unknown, hidden conditions. In most cases, they took care of the problem without additional costs. This included wall and insulation repairs, installation of new expansion joints and new flashing, painting, removal of hardened tar, and the cleanup of water that penetrated the building for one reason or another.
2. Contractors implemented roofing solutions, not previously seen on DISD projects, including flashings, parapet treatments, and penetration treatments.

Table 2: Comparison of Best Past Performance Ratings

No.	Contractor	Original	Updated	% Increase
1	Contractor 17	9.02	8.95	-0.8%
2	Contractor 10	9.82	9.75	-0.8%
3	Contractor 6	8.79	9.32	6.0%
4	Contractor 27	9.36	9.41	0.6%

3. Contractors who had performed under the low-bid process were much more cooperative and perceptive to details and provided quality work not commonly received under the low-bid system.

The post project ratings were very similar to their previous past performance ratings (Table 2). This may indicate that the past performance ratings are a good predictor of future performance and may also indicate that the contractors sent their best crews to these jobs.

After the completion of the roofing projects, the project manager and maintenance manager provided feedback on the traditional design-bid-build process as compared with PIPS. Their feedback generated the following comparisons between PIPS and the low-bid processes:

1. PIPS results rated 10 while the low-bid process rated 1 (10 being highest).
2. Both the project manager and the maintenance manager preferred the PIPS system.
3. PIPS rated 9 for motivating high performance, and design-bid-build rated 1 (10 being highest).
4. PIPS rated 9 for minimizing management and inspection.
5. PIPS reduced management and inspection by an estimated 72.5%.
6. PIPS rated 8.5 for encouraging the contractor to act in the best interest of the owner and to minimize punch list items.

CONCLUSIONS

DISD met all seven objectives set forth in the test. Competition between manufacturers and contractors increased. All of the projects were completed on time, with no contractor cost generated change orders, and with high quality. The installed roofs have solutions that will minimize the maintenance and future repairs on the roofs. The contractors performed to minimize risk, and the warranties provided offered more value. Some warranties were joint and several warranties signed by both the manufacturer and the contractor for the entire length of the warranty. The value has been documented in terms of price and quality. DISD now has the documentation to justify using PIPS instead of the low-bid delivery system. The success of the PIPS tests validates the concept that the low-bid process, and delivering roofing construction as a commodity are inefficient and a cause of construction nonperformance. The results show that a non-technical approach to outsourcing is more successful than a managed technical solution. The results show when the non-technical criteria of on time, on budget, and high quality is measured and used to identify value, the result is high performance. When an owner moves from Quadrant I to Quadrant II, the contractor performance increases and the amount of management

and inspection is minimized. The findings also demonstrate that a win-win relationship is attainable as the owner receives better value and the contractors make a profit. In addition, the overall cost may even be similar to or cheaper than the traditional low-bid process. These results have been duplicated in the State of Hawaii (SOH 2002). DISD faced challenges in implementing PIPS. The first challenge was educating the roofing community, and the second involved the non-decision-making principle. The PIPS project manager had difficulty refraining from making decisions because roofing contractors and manufacturers wanted to form personal relationships. Understanding the procurement system rules was one of the biggest challenges.

RECOMMENDATIONS

This research offers three recommendations:

1. The DISD should monitor and track the performance of low-bid projects and compare the results to the PIPS projects.
2. Contractors and manufacturers should be responsible for sending reference forms to their references, for encouraging their references to fill out the forms, and for instructing their references to forward the forms to the user (DISD). This will minimize 50% of DISD's physical work in managing PIPS.
3. In addition, the user should have the option of roof inspections for previous roof installations. The PIPS process minimizes risk through its structure, and roof inspections should be minimized.

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