

CASE STUDY OF THE IMPACT OF SPECIFICATIONS, CONSTRUCTION MANAGEMENT AND INSPECTION ON CONSTRUCTION PERFORMANCE

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The University of Hawaii was searching for modifications to their construction delivery process that would increase the value and performance of construction and the efficiency of their project management group. The University had been plagued by poor construction performance (not on-time, not on-budget, and not meeting quality expectations). Their goal was to do more construction (with fewer project managers) and minimize the risk of construction nonperformance. The University wanted to study the impact of specifications, construction management, inspections, and the existing low-bid process on construction performance. The Performance Information Procurement System (PIPS) was selected due to its documented results in delivering high performance. There were two objectives for implementing the PIPS process. The first objective was to determine if the University could procure higher quality construction projects by minimizing management, regulations, qualifications, user specifications, and inspections. The second objective of the test would be to document the impact of the PIPS process and satisfaction level of the different parties (contractors, designers, procurement personnel, lawyers, facilities engineers and university leaders) involved in this process.

Keywords: decision analysis, information management, performance, procurement system, quality.

INTRODUCTION

In 1998, the State of Hawaii's Department of Accounting and General Services (DAGS) implemented the Performance Information Procurement System (PIPS). DAGS immediately began noticing a difference in attitude from the contractors who were bidding the projects. As the projects were completed, the State observed significant improvements in performance, which were unlike anything that DAGS had seen before (SOH 2002). The results of the four-year implementation of PIPS were (SOH2002):

1. PIPS resulted in 3% savings of overall project costs.
2. PIPS resulted in greater contractor accountability.
3. PIPS resulted in a lower number of change orders.
4. PIPS provided the State with higher quality construction.

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The States of Utah, Wyoming, and Georgia also implemented the PIPS process on various projects (Byfield 2002, Kashiwagi 1997, Savicky 2003). In the past nine years, the PIPS process has been implemented on over 350 projects (approximately \$170 million of construction). The results of these projects have been 98% on time, 98% on budget, and meeting the user's expectations.

The University of Hawaii (UH), like most other agencies, awarded projects based on the lowest cost. This had been the accepted method of ensuring that the University was receiving quality work, and at the same time, making sure that they were not "paying too much." However, the marginal performance was requiring a high level of owner management. Projects were not completed on time, not on budget, and were not meeting quality expectations.

The UH was not alone in receiving poor quality construction. Many users have also documented the poor performance and poor quality of contractors that have been procured using the low-bid process (Post 2001, Angelo 2001, Hung 2002). A survey conducted by Engineering News Record showed that 42% of the projects surveyed finished late, 33% were over budget, 13% had pending claims, and only 53% of the owners would ever use the contractors again (Post 1998).

In 2000, the UH decided to implement PIPS after recognizing the increase in construction performance that the State of Hawaii had received using the PIPS process. UH also wanted to know if PIPS could do the following:

1. Increase the quality of work.
2. Complete the projects on time, within budget, and with no contractor-cost change orders.
3. Shift risk from the UH to the contractors that were responsible for the work.
4. Provide justified documentation on using best-value procurement to select a contractor / system.
5. Minimizing management, regulations, qualifications, user specifications, and inspections.
6. Optimize the University's Project Management personnel. The UH wanted to see if it could become more efficient by doing more construction work with fewer project managers (or by increasing the number of projects each project manager could successfully manage).

PIPS PROCESS

The Performance Information Procurement System (PIPS) is a process that minimizes risk and optimizes the value of procured construction (Kashiwagi 2001). Using Information Measurement Theory (IMT) principles, PIPS has resulted in 98% customer satisfaction, which is unusual in the construction industry. The PIPS concentrates on minimizing decision-making. Figure 1 shows the major steps of PIPS. The first major step in the process is when contractors and manufacturers are asked to identify their past performance through documentation of proven performance. In the next step, contractors and manufacturers are then asked to identify any risk to the owner and how their services minimize the risks. The vendors then compete on performance (past performance and current capability) and price. Instead of someone making a subjective decision on the value of the performance, PIPS uses an artificial intelligent processor that takes the owner's requirements (in the form of weighted performance criteria and price) and compares each alternative's relative value based on performance and price. The PIPS waits until the final stage to do a technical

review, which is done only with the top prioritized contractor. The contractor and manufacturer present their risk minimized process and material systems to deliver performance. The contractor and manufacturer are required to explain how (in non-technical terms) they will achieve the performance and address the risks in their risk minimization plan.

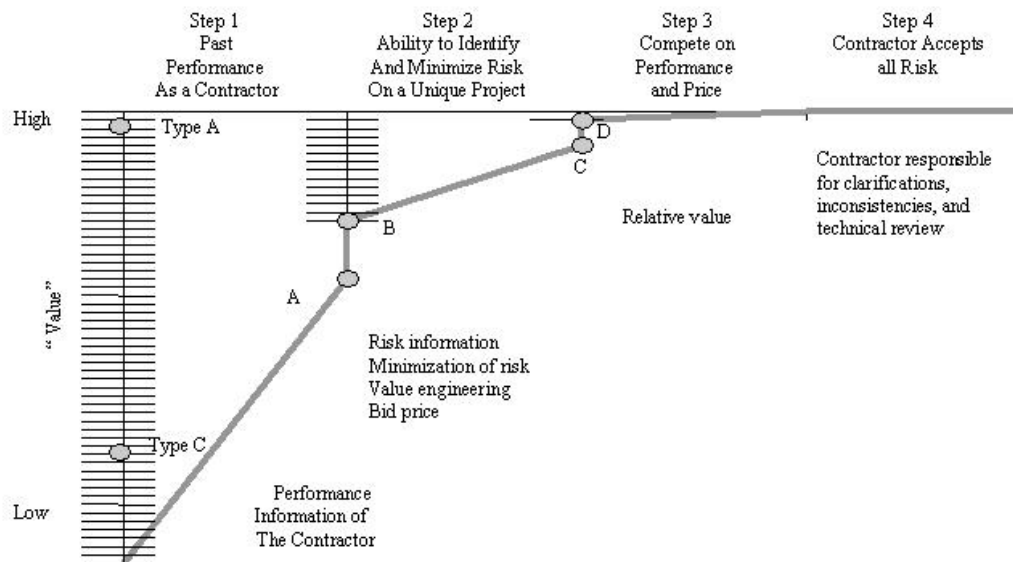


Figure 1: Major PIPS steps

Once the contractor is awarded the project, they (along with the manufacturer) are placed at risk by the PIPS system. This is accomplished by the post-project evaluation, which is a performance rating that is done at the end of the project that will be counted as 25% of their future performance rating. Since the contractor and manufacturer are at risk, they are given total responsibility to make the decisions necessary to get the project done on time, on budget, and meet the quality expectations of the owner. If the contractor, manufacturer, or the supplied system does not perform during the construction, or during the warranty period, their rating will be downgraded, seriously affecting their chances of future projects.

If PIPS is an information-based process, a low performing contractor (that causes 80% of all the owner's problems) will not be competitive. The high performance contractor will always win the project if they are within the owner's budget. For further information on the PIPS selection modeling, see past publications (Kashiwagi 2002).

ANALYSIS

The PIPS process recommends minimizing specifications, management and inspection on the part of the owner. The UH project manager followed these recommendations and ran the test without major modifications to PIPS. The rationale behind these concepts will be addressed.

SPECIFICATIONS AND MINIMUM STANDARDS

Specifications and minimum standards are typically issued to procure commodities. Commodities identify alternatives as being equal. Construction is not a commodity

(the performance of the contractor makes a difference in the finished product). Since many owners have been exposed to poor quality construction, some owners use more specifications in attempt to reduce the risk of nonperformance. However, the owners do not realize that by issuing more specifications, they actually increase the possibility of nonperformance.

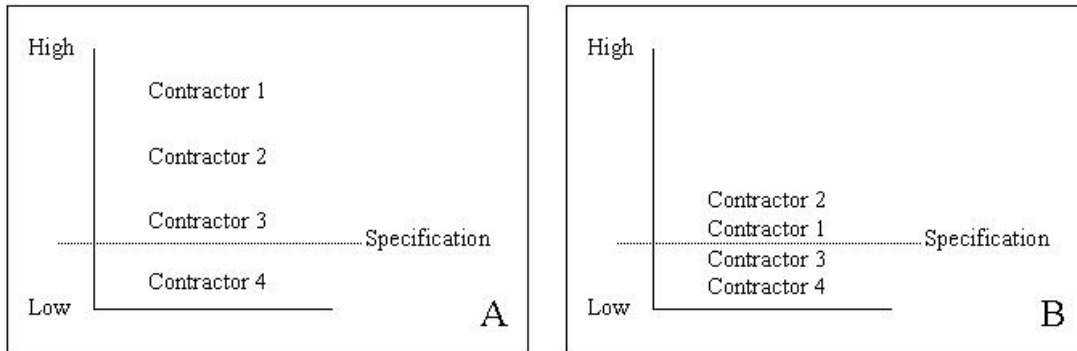


Figure 2: Impact of Minimum Standards on Performance

Figure 2 illustrates four contractors with different levels of performance (Contractor 1 being the highest performer). The dotted line in Figure 2A illustrates that the owner has issued a minimum standard (specification), which represents a minimum level of quality that they are expecting to procure. Figure 2B shows that all of the high performing contractors lower their quality in order to meet the minimum standard. Because construction is not a commodity, quality (by experienced craftspeople and construction managers) and high performance materials, cost more.

The reason why high performing contractors lower their quality is to make a profit. Since the contractors know they are competing against each other, they will lower their cost in order to increase their chance of being awarded the job. If high performing contractors lower their price, but offer the same high performance, they would suffer a loss in profit. High performing contractors are forced to lower their quality by minimum standards and specifications. This adversarial conflict between the contractor and the owner is illustrated in Figure 3.

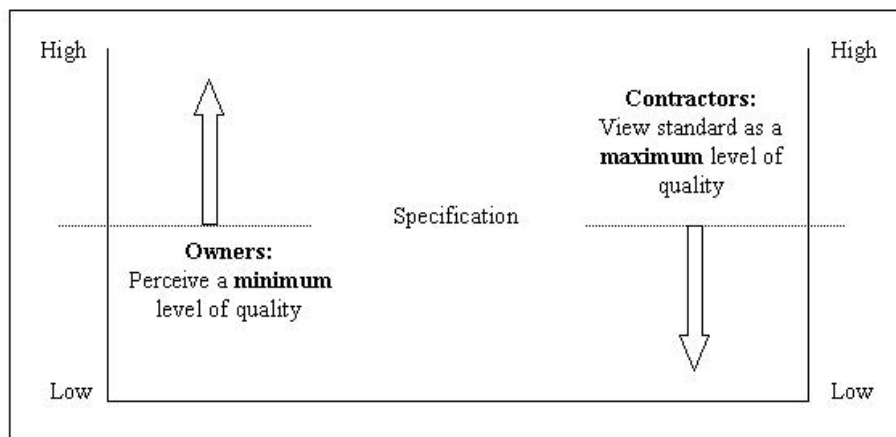


Figure 3: Owners vs. Contractors: Difference in Objectives

Owners believe minimum standards will result in contractors performing higher quality work than what was specified. Contractors view the minimum standard as the maximum level of acceptable quality (anything over the minimum results in a loss of profit). The contractor will give the owner the least amount of quality. The less quality that is delivered, the larger the profit of the contractor. Thus, there is an inherent conflict in the best interest of the owner and contractor.

OWNER MANAGEMENT AND INSPECTION

The fundamental idea behind minimizing owner management and inspection is efficiency and outsourcing. When companies outsource a task, they partner with another company that can perform the task more efficiently, and with higher quality. The objective is to hire an expert and let the expert do their job.

The PIPS process treats construction in a similar manner. The process identifies a performing contractor (expert) and encourages the owner to let the expert do their job. This results in the minimization of the owner's management and inspection. The expert is now responsible for performing the necessary quality control. Outsourcing construction services and then attempting to manage the outsourced services is not efficient and dilutes liability and responsibility.

The PIPS process encourages the owner to hire an expert and let the expert do their job with as little management and inspection as necessary. When a contractor assumes the risk of construction non-performance, they are forced to assign their most skilled craftspeople. The PIPS process minimizes risk, instead of just moving the risk to another party.

IMPACT OF THE LOW-BID PROCUREMENT PROCESS

The low-bid award process assumes that all alternatives are delivering the same level of quality and identifies the lowest bid as the best value to the owner. High performing contractors must lower their level of performance to be competitive. By cutting performance (experienced project managers and site superintendents, high performance materials, and highly skilled craftspeople) a contractor can lower their price. Thus, instead of getting credit for performance (which motivates contractors to perform), the performing contractor is forced to reduce their quality to compete with the lowest priced contractor. The owner then identifies a professional designer or engineer to minimize the risk caused by minimal standards and the low-bid process. The risk is introduced because the minimum standards rarely have correlation with documented past performance. The professional must make a subjective decision if the contractor with the lowest price meets the minimum standards. The owner's representative then manages and inspects the contractor to make sure they are meeting the minimum level of quality. In many cases, the projects are completed late, have costly change orders, or result in poor quality (Post 2002).

IMPLEMENTATION OF PIPS BY UH

The UH ran PIPS in three different areas: painting, roofing projects and gymnasium sports flooring. The UH PIPS project manager noticed a positive change in contractor attitude soon after PIPS was implemented. The project manager strictly followed the three basic rules of the PIPS process, which are:

1. Minimize decision-making.
2. Minimize the amount of work performed by the UH project managers.

3. Minimize risk.

PAINTING PROJECTS

No technical specifications were issued on eleven painting projects. The project manager’s only requirement was the desired color coordination of the buildings. The award would go to the contractor who proposed the best value, longest warranty with a proven past performance, and could offer the work within the University’s budget. This was a complete shift in the manner in which painting projects had been previously awarded. The project manager stated the contractors would be responsible for identifying what they could install, the quality they could provide, and the cost it would take to do the entire project. Some contractors, who may have been inexperienced at identifying their performance, did not participate in this process. The remaining contractors competed based on price, past performance history, and their ability to identify and minimize potential risk.

The project manager did not make any decisions during the projects. The project manager told the contractors that the minimum level of quality they should provide should be the minimum level of quality they would require if they were painting their own homes. Once the project was awarded, the contractors began asking the project manager to check their quality of work. The project manager refused, knowing that user inspection brings risk (the contractors should be quality controlling their own work). The project manager did perform spot checks during walk-throughs to assist the contractors. If there were problems, the contractor immediately responded without the assistance of the project manager. Overall, the amount of management, inspection, control, and decision-making was minimized by 80%.

RESULTS

The results of the UH projects were consistent with other PIPS projects. The projects were finished on time, within budget, had no change orders, and very high quality. Table 1 summarizes the overall results of the UH-PIPS painting projects:

Table 1: University of Hawaii PIPS Painting Results

Criteria	Results
Total Number of Projects Awarded	11
Overall Estimated Budget	\$ 2,310,000
Total Award Cost	\$ 1,658,192
Percent Over/Under Budget	-28%
Number of Different Contractors Awarded Jobs	6
Percent of Jobs Completed Within Budget	100%
Percent of Jobs Completed On Time	100%
Percent of Jobs Completed Ahead Of Time	90%
Percent of Projects Where Contractor Performed Additional Work at No Charge	56%
Average Post Project Rating (Maximum is 10)	9.8

Table 2 illustrates the overall comparison of the Low-Bid process compared to the PIPS process (as identified by the UH Project manager and awarded PIPS contractors).

Table 3 illustrates the evaluation of factors relating to the movement from the low-bid process to the PIPS process. Table 3 is also illustrating the comparisons of the percent decrease of: change orders, punch list items, specifications, design work, user inspection, and user management when moving from the low-bid process to the PIPS

process. The UH Project manager and four contractors (that were awarded a PIPS project) evaluated the PIPS system.

Table 2: Overall Comparison of the Low-Bid Process and the PIPS Process

No	Criteria	LB	PIPS
1	Ability to encourage contractors to perform high quality work.	2.33	9.67
2	Overall performance of contractors.	3.17	9.08
3	Overall quality of projects procured.	3.17	9.08
4	Overall satisfaction.	2.83	9.17
5	Percent of individuals that would rather use PIPS over Low-Bid.		100%
6	Percent of individuals that were satisfied with PIPS.		100%

Table 3: Evaluation of Factors

No	Criteria	Contractor Ratings	UH Ratings
1	Percent decrease in cost generated change orders	83%	75%
2	Percent decrease in the number of punch list items	96%	75%
3	Percent decrease in the amount of detailed specifications	91%	75%
4	Percent decrease in the amount of design work	17%	75%
5	Percent decrease in user inspections	63%	80%
6	Percent decrease in the amount of user management	13%	80%

Table 4 analyzes the perception of the contractors and the UH project manager towards the comfort levels of the different parties involved with construction procurement. This includes the analysis of Industry Training Programs, Designers, Procurement Personnel, Lawyers, Engineers, and University Leaders with the PIPS process

Table 4: Comfort Levels of the Industry

No	Criteria	UH Ratings	Contractor Ratings
1	Percent that felt that the PIPS process was a fair process	100%	100%
2	Percent that felt that the Low-Bid process was a fair process	100%	33%
3	Percent of individuals that would use PIPS rather than Low-Bid	100%	100%
4	Percent that felt that there was political pressure with the PIPS process	0%	25%
5	Percent that felt that there were legal pressures with the PIPS process	100%	25%
6	Overall comfort level of the contractors involved with the PIPS process.	9.0	9.0
7	Comfort level of the industry training programs with the PIPS process.	8.0	7.5
8	Comfort level of the designers with the PIPS process.	9.0	6.7
9	Comfort level of the procurement personnel involved.	3.0	7.3
10	Comfort level of the lawyers involved with the PIPS process.	3.0	4.5
11	Comfort level of the facility engineers involved with the PIPS process.	5.0	9.3
12	Comfort level of the university leaders with the PIPS process.	5.0	8.0
13	Overall acceptability of the PIPS process	5.0	5.0

These numbers clearly indicate that UH was able to achieve its objective of procuring higher quality construction projects by minimizing; management, regulations, qualifications, user specifications, and inspections

The UH project manager had worked for the university for approximately 15 years, and had previous experience working for a general contractor for 15 years. The project manager stated:

“In all my years of construction experience (both in the private and public sectors) I have never been more impressed with a procurement process such as the process provided by PIPS.”

He also stated:

“The system promotes a partnering ‘win-win’ scenario between the owner and the contractor that require minimum project management resulting in on time, on budget and outstanding quality construction.” (Serikawa 2002)

The project manager observed that the contractors involved were extremely comfortable with the PIPS process and felt that they would rather use the PIPS process than the low-bid process in future. This indicates that high performing contractors liked the system. The Project manager noted that one contractor was not comfortable with PIPS. This contractor had received awards under the low bid system, but was not being awarded any PIPS projects. The contractor was not competitive when both performance and price was considered. In addition, the project manager observed that the procurement personnel, University lawyers, facility engineers and university leaders were all uncomfortable with the PIPS process. This is not uncommon since individuals are afraid of change.

CONCLUSION

By implementing the PIPS process based on performance and price, UH procured higher quality construction projects and minimized project management requirements. The test results support the hypothesis that the low-bid award process may be the reason for poor construction performance. The high performance can be related to the minimization of project management, inspection, and specifications, which are required under the traditional low-bid environment. These results validate the Construction Industry Structure model.

The UH Project manager and the majority of contractors felt very comfortable with the PIPS process and stated that PIPS resulted in a substantial increase in overall performance. However, the procurement personnel were uncomfortable with the process due to the minimization of control and procurement functions, and the University lawyers were uncomfortable due to a change in thinking and the inability to understand the concepts of performance information. The University chose to return to the low bid environment and increase project management of construction. In the past year, they have tried to come up with another process, which attempts to duplicate the results of PIPS, but have not been successful. This resulted in the retirement of the project manager who was assisting the University in implementing PIPS or a substitute performance based process. His final statement was, “I am convinced that PIPS is the only way to go, especially for a public institution.” (Serikawa 2003)

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