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CONTENTS

1 Influence of Delivery Methods and Legislative Impediments on Project Performance Information
Valerie R. Riecke Smith, Daniel Castro-Lacouture and Rita Oberle

13 Past Performance Information: Analysis of the Optimization of a Performance Evaluation Criteria
Kenneth T. Sullivan and John Savicky

23 Best-Value Process Implementation at the City of Peoria: Five Years of Research Testing
Kenneth T. Sullivan, John Savicky and Brad Carey

33 The Dutch Construction Industry: An Overview and Its Use of Performance Information
Jeroen van de Rijt and Michael Hompes

57 A Case Study of a Best Value Manufacturer
Dean Kashiwagi, Jake Smithwick, Jacob Kashiwagi, and Kenneth Sullivan

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Influence of Delivery Methods and Legislative Impediments on Project Performance Information

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The choice of a suitable delivery method plays a considerable role in the performance of a construction project. Previous research has attempted the development of a systematic approach to project delivery method selection focusing on performance information. However, such attempts did not properly address public agencies and legislative impediments are almost entirely neglected as suggested variables in such models. This paper addresses these limitations by presenting a quantitative analysis to test whether federal and state legal limitations do influence project performance. Project characteristics from the U.S. General Services Administration Capital Construction Project database are presented. The database is analyzed using cross-tabulation to determine potential correlations among the variables, and specifically their relation to project delivery method choice and performance information. Contributions from this research are reflected in presenting a methodology for choosing alternative delivery methods while considering project characteristics and specifically the legislative impediments associated with a construction project and their influence on project performance.

Keywords: Delivery Method, Legislative Impediments, Performance Information

Introduction

Researchers and practitioners are constantly seeking to determine which construction project delivery method best suits a project. This project delivery method selection process is part of the programming phase of a project, and typically is overshadowed by the need to determine sufficient program definition during the same phase. This problem is exacerbated in alternative project delivery methods in that the public owner does not have the design reviews that are common in traditional construction delivery methods. The construction industry has not established a standard definition of the project delivery method process, nor has it established accepted types and definitions of project delivery methods. Because of this, federal, state and local legislation and trade organizations have established their own definitions of the process and the types of project delivery methods. This has resulted in multiple interpretations of the project delivery method process.

In 2004, members from the American Institute of Architects (AIA) and The Associated General Contractors of America (AGC) trade organizations formed a task force to develop a basic understanding of the project delivery method process and definitions for the three primary project delivery methods: design-bid-build, construction manager at-risk, and design-build. Their goal was to “provide the industry with a set of definitions that others can use as a baseline…against which people can reconcile their own set of definitions” (AIA and AGC 2004). Those definitions are used as a baseline for this research, and are supplemented by federal and state legislation and a literature review of published research. The AIA and AGC have not established a standard definition for the project delivery method process. Rather, they provide a discussion on “management” versus “delivery,” associating the term “delivery” with project delivery method. Delivery is termed as the assignment of responsibility for providing design and construction services. Management is the coordination of the design and construction process. The AIA and AGC associate the assignment of responsibility as the fundamental difference between project delivery methods.

In the construction industry, there are three primary methods of project delivery. Construction industry professionals commonly refer to a “traditional” form of project delivery known as design-bid-build. There are two variations of this traditional form: design-bid-build using separate-prime bidding method, and design-bid-build using single-prime bidding method for project delivery. These methods obligate public owners to award construction contracts based on the lowest, most responsible and responsive bidder. In the past decade, the choices of methods have expanded and are referred to as “alternative delivery methods.” These are the construction manager at-risk and design-build project delivery methods. These alternative delivery methods obligate the public owner to award contracts based on a combination of qualifications and cost, or best value.

The General Services Administration (GSA) applies several variations of these primary project delivery methods. First, GSA does not use the design-bid-build using separate-prime bidding method; however, GSA does use the design-bid-build using single-prime bidding and the design-build methods. GSA also has a variation of the design-build project delivery method, referred to as design-build-bridging. Instead of the public owner preparing a detailed project program as in design-build, in design-build-bridging, the public owner solicits a separate design entity, based on qualifications to complete the design through the design development phase. This design entity is referred to as a bridging architect. Once design is complete through the design development phase (approximately 35 percent), the public owner requests proposals to attract a design-builder to complete the design and perform construction. The balance of the design and construction phases is awarded to a single entity. Under this design-build variation, construction still typically begins before the design documents are complete, and the public owner hold two contracts, one with the design entity that completes the design through the design development phase, and a second contract with a design-builder who finishes the design and performs construction, as depicted in Figure 1. GSA also uses the construction manager at-risk method of project delivery; however, GSA also has a variation of this method and refers to that variation as construction manager as-constructor. GSA’s construction manager as-constructor has the same four sequential phases of project delivery as in the construction manager at-risk project delivery method: selection (of a designer), design, bid-selection (of a construction manager), and construction

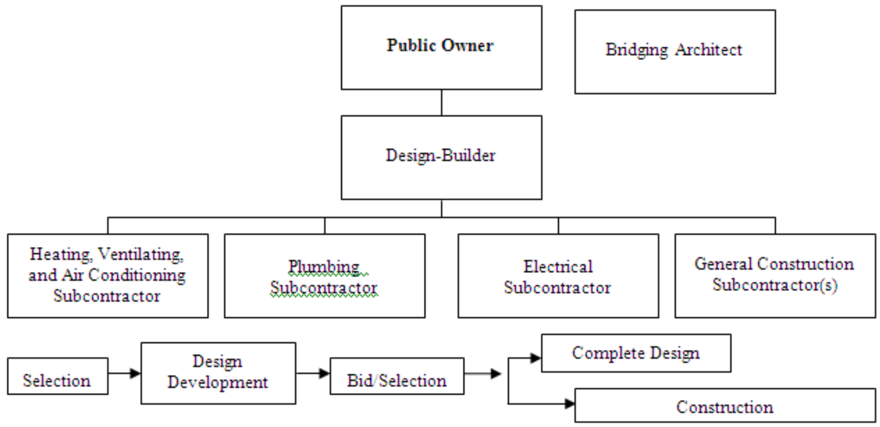

Figure 1: Design-Build-Bridging Organizational Chart

GSA develops the project program and then requests proposals from prospective designers and then awards the contract on the basis of qualifications. The designer then develops design documents. During this process, GSA requests proposals from prospective construction managers and selects on the basis of qualifications and of cost. Once the construction manager is selected, the contract has two phases of execution. In the pre-construction phase, the construction manager works with GSA and the designers for constructability reviews until the design documents are usually complete. GSA has the option to determine how complete the design documents should be before construction negotiations begin. GSA has an option to negotiate the cost of construction based on a guaranteed maximum price, based on a fixed cost or based on a cost-plus-fee. Figure 2 presents the construction manager as-constructor organization chart.

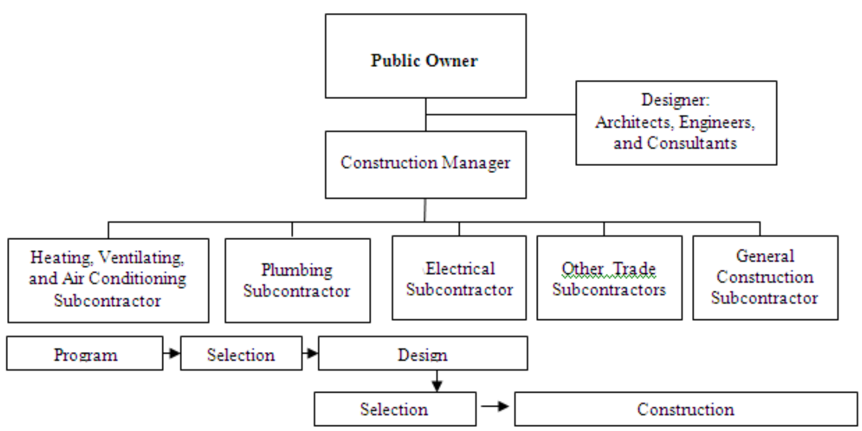

Figure 2: Construction Manager as-Constructor Organizational Chart

The use of project delivery methods can be traced back to the evolution of design and construction when ancient master builders provided a seamless service that included what is now referred to as design and construction, or design-build. In the past two centuries, in the dawn of the Industrial Revolution, the design and construction industry has become more specialized and segmented. In response to the growing segmentation of the construction industry, laws, beginning with the Miller Act of 1935, have been enacted to legally separate the duties of design and construction on federal projects in the United States.

This growing segmentation in the industry also prompted Congress to enact the Federal Property and Administrative Services Act of 1949, the first public contract laws mandating the separation of design and construction. This law requires the selection of builders on public contracts through open competition and based on the lowest responsible bid. The Brooks Architect-Engineer's Act, enacted in 1972, is believed to have solidified the separation of design and construction by requiring public owners to award architectural and engineering contracts based solely on qualifications. The theory behind the law is that, since federal projects are built by the lowest cost builder, the designs for the project should be developed by the highest qualified design firm. The enactment of these two laws is the basis for much debate and research in the public construction industry. Public owners who are without experience in alternative project delivery methods or who are unsure about the appropriate application will opt for the traditional method of project delivery, design-bid-build, and face the risks associated with its low-bid process.

Previous research has demonstrated that the selection of an appropriate delivery method contributes significantly to the outcome of a design and construction project (Chan et al. 2002; Love 2002; Chan et al. 2004). And while no one system is superior in all circumstances, there is probably a best choice for any specific project (Dell'Isola et al. 1998). Many owners base their project delivery method choice upon biased experience of in-house experts and/or advice from external consultants (Masterman 1992; Masterman and Duff 1994). Other owners use project delivery methods based on over-simplified practices that "take into account the characteristics of each job rather than adopt a method developed from detailed consideration of both the projects themselves and their effects on the ongoing business of the organization" (Griffith and Headley 1997). Skitmore and Marsden (1988) explored the development and application of a more systematic approach to project delivery method selection. Since then, there is substantial research that suggests and even attempts to develop a systematic approach to project delivery method selection. However, existing literature rarely addresses public agencies and legislative impediments are almost entirely neglected. Over the past several decades, there has been growing dissention toward the design-bid-build project delivery method. Critics claim that choosing a builder based on the lowest price under the design-bid-build method supports unscrupulous behavior. This growing dissention has led to court cases to challenge the Brooks Act, which evolved to the passage of the National Defense Authorization Act of 1996, re-named the Clinger-Cohen Act. This Act allows all federal agencies to award one contract to an entity or team of entities to design and build the construction project. However, many federal agencies and state governments have yet to embrace design-build as a viable procurement system. Five years after the Clinger-Cohen Act was passed, almost half of all states did not allow design-build. And 10 years after its enactment, there are still five states that forbid design-build, and of those that allowed it, many are highly restrictive in its use.

This paper addresses legal legislative limitations inherent in the public construction industry by presenting an analysis that can be integrated into existing models and taken into consideration when choosing a project delivery method. The analysis uses a series of multivariate flowcharts that reflect how project delivery methods influence project performance. These flowcharts guide public owners in determining the advantages and disadvantages of alternative project delivery methods, such as design-build and construction manager at-risk. The analysis aids public owners and the construction industry by identifying, testing and analyzing the impact of legislative impediments in the delivery method selection process and on project performance.

Research Hypothesis and Data

The data used to test the research hypothesis, whether benefits exist to public owners when using alternative project delivery methods and whether benefits exist to public owners when legislative impediments are lifted, and alternative project delivery methods are allowed to be used, is provided from GSA's Project Information Portal (PIP). The PIP is a nationwide system for tracking the GSA Public Buildings Services (PBS) capital construction program, where users can obtain project information, from its design renderings, construction photos, or completed project views.

The database includes project characteristics or variables to assist Congress and GSA executives to track the progress of such projects. These variables are: (1) Region; (2) Project Type; (3) Program Area; (4) Project Delivery Method; (5) Political Party; (6) Gross Area; (7) Usable Space; (8) Congress Authorization; (9) Conference Appropriation; (10) Central Office Allowance; (11) Estimated Total Prospectus Cost; (12) Estimated Total Prospectus Cost Site; (13) Estimated Total Prospectus Cost Design; (14) Estimated Total Prospectus Cost Construction; (15) Congress Authorization Year; (16) Planning Phase Duration; (17) Design Phase Duration; and (18) Construction Phase Duration. Several of these variables were grouped to analyze the data in more detail: (19) Congress Authorization to Construction Finish Duration; (20) Planning Start to Construction Finish Duration; and (21) Design Start to Construction Finish Duration. To test the hypothesis, whether benefits exist when alternative project delivery methods are used and whether legislative limitations allowing the use of alternative project delivery methods impede any such benefits to be realized, the researcher adds two new variables to the database: (22) Federal Legislation and (23) State Legislation.

This database is selected for this research and the variables contained within it are used because GSA's Project Information Portal (PIP) is the most comprehensive database that could be found. This database also is required through congressional mandate and so the variables within it are required through such mandate. The goal is to take a quantitative approach to determining whether benefits exist to a public owner when alternative project delivery methods, specifically design-build, are used for a construction project, and whether legislative limitations allowing the use of such alternative methods impede such benefits to be realized. To test the hypothesis, whether benefits exist when alternative project delivery methods are used and whether legislative limitations allowing the use of alternative project delivery methods impede any such benefits to be realized, Federal Legislation was added as a new variable to the database. Federal Legislation represents if the 1996 Clinger-Cohen Act is passed into law when Congress authorized funding for the project. The 1996 Clinger-Cohen Act allows qualifications-based selection of builders using the design-build and construction manager as-constructor forms of project delivery. This new variable provides information to explore the benefits of using alternative project delivery methods. Within GSA's database, more than half of all projects are built using design-bid-build using single-prime bidding, or 252 projects, as presented in Table 1.

Table 1

Project Delivery Method Distribution

Delivery Method	Frequency	Percent	Valid Percent	Cumulative Percent
Design-Bid-Build (Traditional)	252	50.8	50.8	50.8
Design-Build	100	20.2	20.2	71.0
Design-Build Bridging	69	13.9	13.9	84.9
Construction Manager as Constructor	75	15.1	15.1	100.0
Total	496	100.0	100.0	

Fifty-six projects in the database are approved by Congress before the Clinger-Cohen Act is enacted; these projects were approved by Congress before 1996. Three hundred and twenty-five projects in the database are approved after the Clinger-Cohen Act is enacted, or from fiscal year 1996 to 2008. And 115 projects in the database do not provide such information and those projects have missing data. These results in the database are depicted in Table 2.

Table 2

Descriptive Statistics of Federal Legislation

Clinger-Cohen Act of 1996	Number of Projects (Frequency)	Percent
Enacted before 1996	56	11.3
Enacted after 1996, and including 1996	325	65.5
Missing	115	23.2
Total	496	100.0

Quantitative Analysis

Cross-tabulation analyzes the relationships between independent and dependent variables, or between defined problems and factors contributing to those problems. This investigates cause-and-effect relationships, looking at the extent to which one variable (i.e., the cause) influences another variable (i.e., the effect) (Leedy and Ormrod 2005). A variable that is studied in research as a possible cause of something else is the independent variable. A variable that is potentially influenced by the independent variable is the dependent variable, because it depends on the independent variable. In this paper, the dependent variable is the project delivery method and the independent variables are the project characteristics, and specifically the variables to test the hypothesis, the legislative impediments. Cross-tabulations are performed using the dependent and independent variables to test the relationship of the associations. As explained before, there are 22 independent variables and one dependent variable (i.e., project delivery method) in the database, and all independent variables are analyzed using cross-tabulations in this section. While cross-tabulations provide the relationship among two variables, it does not address the strength of the association. While it is possible to examine the strength of the relationship by modeling two or more independent variables, the scope of this paper to is to extrapolate information from the project variables and explore their relationship with project delivery method selection.

Project Prospectus Cost Performance Information

Figure 3 shows the performance relationship between the mean Estimated Project Prospectus Cost and the project delivery method, for several project stages. The Estimated Total Prospectus Cost (ETPC) for the dataset reveals that projects using the design-bid-build delivery method, on average, are funded most heavily, with an average of $39,821,994 for all projects. Projects using construction manager as-constructor delivery method rank second in funding, with an average of $79,664,448. Design-build projects rank third with an average of $25,360,700 in funding and design-build-bridging rank last with an average of $13,306,191 in funding. The Estimated Total Prospectus Cost for site work suggests that more monies are projected for projects using design-build than all other project delivery methods, with $8,583,303. However, monies distributed for site work seem to be, on average, about the same for design-bid-build and construction manager as-constructor, higher for design-build and lower for design-build-bridging. Projects using construction manager as-constructor, on average, allocate $7,245,120 for site work, and projects using design-bid-build allocate an average of $7,239,317. Projects using design-build-bridging rank last with an average of $6,258,827 for site work.

An analysis of the Estimated Total Prospectus Cost for the design phase reveals that more funds, on average, are allocated for projects using the construction manager as-constructor delivery method, with projects receiving an average of $6,052,676. Significantly fewer funds are allocated to projects, on average, under other delivery methods. Projects using design-bid-build received an average of $4,435,802, while projects using design-build-bridging receive $3,551,847, and those using design-build receive $2,681,195. Design costs for projects using design-build are one-third of design costs for projects using construction manager as-constructor.

The estimated total prospectus cost for construction is significantly higher for projects using construction manager as-constructor, with an average of $80,747,864. Projects using design-build-bridging are allocated an average of $52,838,345, while those using design-bid-build average $47,689,315, and those projects using design-build average $41,991,151.

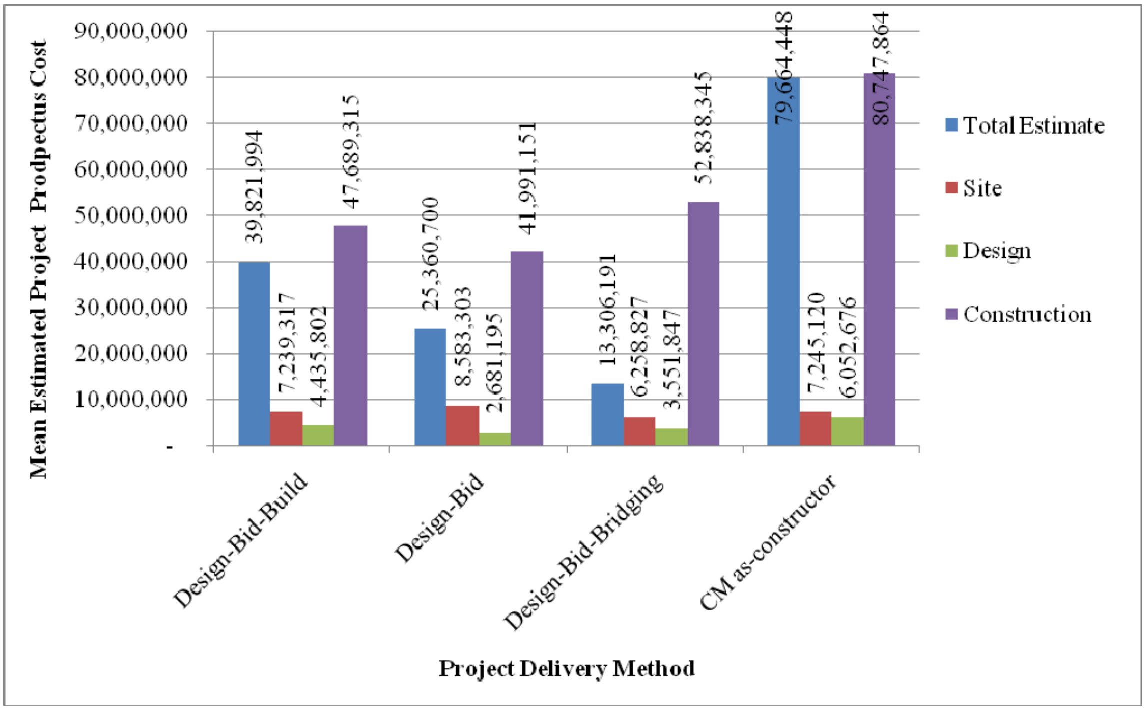

Figure 3: Cross-Tabulation of Estimated Project Prospectus Cost and Project Delivery Method (Dollars)

Project Phase Duration Performance Information

The cross-tabulation analysis reveals that the average number of days in the planning phase varies only slightly between project delivery methods. Figure 4 shows the average number of days in several phases of project development. As seen in the figure, the average number of days in the planning phase for design-build-bridging is 996 and the average for design-bid-build is 970; the figure also shows an average of 950 days for construction manager as-constructor, and 928 days for design-build.

An analysis of the time to complete design varies significantly between project delivery methods. Projects using design-build have the shortest design period, with only an average of 604 days, whereas projects using design-bid-build average 840 days, those using design-build-bridging average 930 days, and those projects using construction manager as-constructor average 1,077 days. There is a great difference in the number of days (duration), on average, for these methods and the cross-tabulation analysis suggests that it may take twice as long to complete design using construction manager as-constructor than it does using the design-build delivery method.

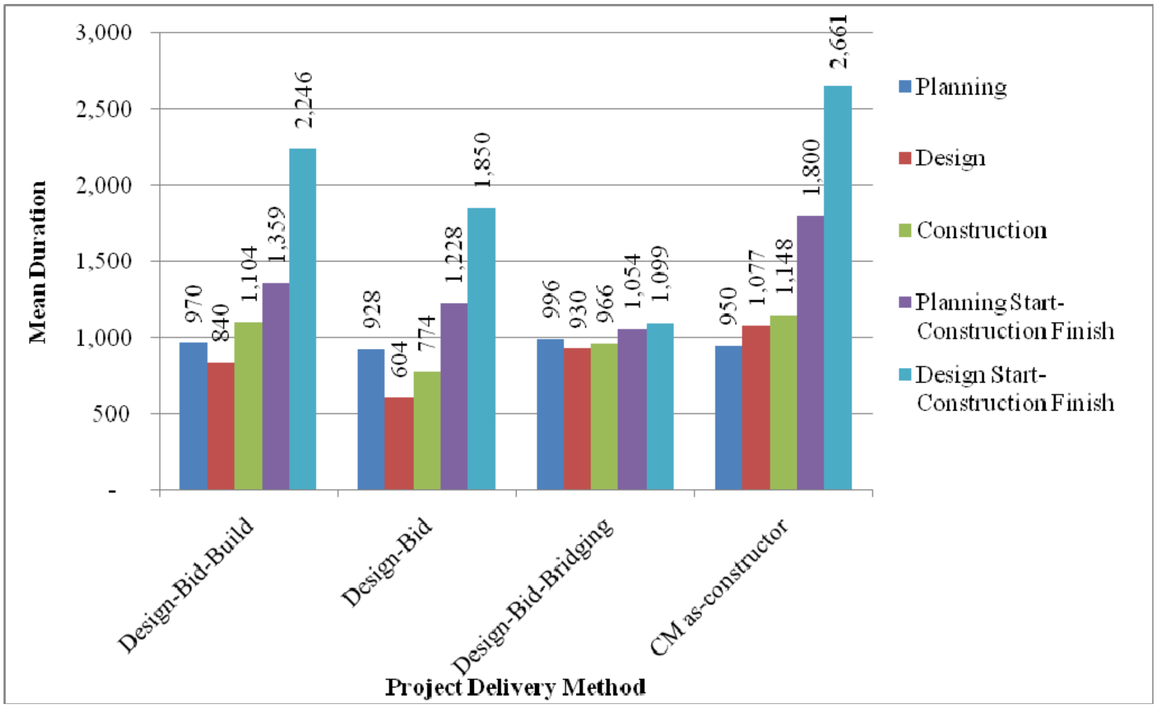

Figure 4: Cross-Tabulation of Project Phase Duration and Project Delivery Method (Days)

The construction phase using construction manager as-constructor and design-bid-build are almost the same. Projects using construction manager as-constructor extend 1,148 days, and projects using design-bid-build extend an average of 1,104 days. Projects using design-build-bridging and design-build suggest time savings. Design-build-bridging projects average 966 days for construction and projects using design-build average 774 days. The analysis reveals that there is a significant discrepancy in the amount of time to administer the construction using construction manager as-constructor versus design-build, with a savings of 32 percent.

Cross-tabulation analysis indicating the duration between when the planning phase begins and when construction is complete suggests that projects using the construction manager as-constructor method have the longest duration, extending an average of 1,800 days. The analysis suggests that projects using design-build-bridging have the shortest duration with an average 1,054 days. Projects using design-bid-build rank second in longest durations with 1,359 days, and projects using design-build rank third with longest duration with 1,228 days.

The duration, on average, from when a design begins and when construction ends is telling. Similar to other cross-tabulations of time, projects using the construction manager as-constructor, on average, have the longest durations, with 2,661 days, as depicted in Figure 4. Cross-tabulations also suggest that projects using design-build-bridging have significantly lower durations, with an average of 1,099 days for design and construction phases. Projects using design-bid-build rank second in longest durations with an average of 2,246 days, and projects using design-build for project delivery average 1,850 days for design and construction activities.

Legislative Impediments and Performance Information

For both federal and state scenarios, it was tested whether performance benefits exist when alternative project delivery methods are used and whether legislative limitations allowing the use of alternative project delivery methods impede any such benefits to be realized.

Federal Legislation

Cross tabulation of the project delivery method and whether the 1996 Clinger-Cohen Act was passed when Congress authorized funding for the project is analyzed, as presented in Table 3.

Table 3

Cross-Tabulation of Project Delivery Method and Federal Legislation (Number of Projects)

	Federal Legislation			
	No	**Yes**	**Missing**	**Total**
Design-Bid-Build	44	173	35	252
Design-Build	4	73	23	100
Design-Build-Bridging	1	16	52	69
Construction Manager as Constructor	7	63	5	75
Total	56	325	115	496

This analysis reveals that design-bid-build is the project delivery method chosen more often project after the Clinger-Cohen Act is enacted. GSA public owners have lessened legislative restrictions on using an alternative delivery method and still choose design-bid-build. There are significant numbers of projects that choose design-build, design-build-bridging and construction manager as constructor once those legislative barriers are lifted. Only four projects choose design-build before 1996, and 73 choose design-build after 1996. There seems to be a trend using cross tabulation for the analysis.

State Legislation

Similar to Federal Legislation, cross-tabulation is explored to determine if there is trend in project delivery method selection and if design-build is authorized in the state when Congress authorized funding for the project. This tests whether benefits are realized when an alternative delivery method is chosen for a federal project when there are lessened legislative barriers at the state level. The results are presented in Table 4. The analysis reveals that more federal projects choose an alternative delivery method if state legislation (i.e., in the state the project is located) allows the use of design-build. This is true in all delivery methods, except for design-build-bridging. The use of design-build for federal projects doubled in states that allow design-build. The use of design-bid-build stays almost stable and yet there is only a slight increase when there are lessened state legislative barriers. Using cross tabulation indicates a trend in the use of design-build with lessened state legislative barriers.

Table 4

Cross-Tabulation of Project Delivery Method and State Legislation (Number of Projects)

	State Legislation			
	No	**Yes**	**Missing**	**Total**
Design-Bid-Build	81	86	85	252
Design-Build	22	49	29	100
Design-Build-Bridging	8	4	57	69
CM as Constructor	25	28	22	75
Total	136	167	193	496

Conclusions

The cross-tabulation analysis reveals that the largest projects in size use alternative delivery methods, such as design-build and construction manager as-constructor. Design costs are lower using design-build and design-build-bridging than other methods, and projects using construction manager as-constructor have the longest duration. This may be because one contract is awarded for design and construction and two or more contracts are awarded for the other methods. The cross-tabulation analysis also reveals that there is an increase in the use of alternative delivery methods, especially design-build, once federal and state legislative barriers are lifted. Before Clinger-Cohen was passed in 1996, only 4 projects choose design-build; after this law is passed, 73 projects choose design-build. Design-build is selected twice as much after state legislative barriers are lifted. Cross-tabulations suggest a relationship among legislative impediments and project delivery method selection.

However, while cross-tabulation as an analysis technique describes the relationship among two variables, it does not measure the strength of the relationship and does not describe whether a statistically significant relationship exists among the variables. This methodology proves to be a valuable approach in analyzing the effect of legislative impediments on the performance of a construction project, and is recommended for future research in the construction industry.

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Past Performance Information: Analysis of the Optimization of a Performance Evaluation Criteria

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Performance information has been defined as "the set of metrics used to quantify both the efficiency and effectiveness of actions (Neely 1995)." From this definition, past performance information can be extrapolated to entail those metrics that consider the effectiveness of past or previous actions. Within value-based procurement methodologies, the use of past performance information as an evaluation criteria is common; however, the optimal use, method, specific criteria, and collection techniques vary widely across clients and buyers. This paper presents a history and evolution of the use of past performance information within a specific procurement and project delivery process called the Performance Information Procurement System (PIPS). It also includes an analysis of the modifications made, an analysis of the effort required for the inclusion of past performance information as a selection criteria as calculated from the procurer's perspective, and an analysis of a new methodology of a vendor driven collection process as compared to a buyer driven collection process.

Keywords: performance information, value based selection, performance metrics, past performance information

Introduction

The construction industry is under increasing pressure to improve its practices (Hill 1991), and is suffering from a lack of performance. "Performance management is a growing concept in construction and this is evidenced by the numerous methodologies and approaches to measuring that have recently been introduced (Lee 2000)." Within the construction industry the objective of performance information is to impact and improve construction performance (Kashiwagi 2008). Performance information has been defined as "the set of metrics used to quantify both the efficiency and effectiveness of actions (Neely 1995)." Key metrics that apply to performance information in the construction industry correspond to cost, schedule, and customer satisfaction. It is proposed that simply quantifying the effectiveness of a contractor or project is not effective. The data that is collected and measured must be used to affect change in either the client organization, the contractor, or in the project itself in order for it to be effective.

Performance information is a widely used research topic; however, very few publications have addressed this vital component. In a recent 2009 CIB Working Commission 117 report, it was found that after examining over 4500 academic articles on performance information, only four proposed systems were able to demonstrate the repeated use of performance information to motivate an increase in efficiency (Egbu et. al 2008). Of these four, only one dominantly demonstrated the use of performance information over an extensive range of repeated hypothesis testing, and this was the Best Value Performance Information Procurement System.

A key aspect of the Performance Information Procurement System (PIPS) is the incorporation of past performance information into the selection criteria for contractors, designers, and other services providers in bid and RFP processes. This paper traces the development, modifications, and future of the use of past performance information (PPI) within the PIPS process, showing the evolution and refinement of an idea to its most optimized state.

History of Past Performance Information Modifications

Past performance information, or PPI, has undergone significant changes in the PIPS process throughout the past 14 years. The most substantial changes to the PPI process, which were implemented to increase the efficiency of the process for both the client and the vendor, are documented in Table 1.

Table 1

Changes to the Past Performance Information (PPI) process

No	Modification Made	Date
1	Requiring past performance information on key individuals	1999
2	Minimizing the need to physically inspect all past projects	2003
3	Creating a standard survey questionnaire and minimizing the number of criteria	2004
4	Requiring the vendor to create and send out survey forms to past clients	2004

Requiring past performance information on key individuals

Prior to 1999, the PPI process only required past performance information on the firm that was competing on a project. As the PBSRG increased their research in large general construction projects, it was discovered that the key individuals on the project played an extremely important role in the overall success of a project. In 1999, the PPI process was modified to allow clients an opportunity to collect past performance information on key individuals that would be assigned to their project. This included the project manager and site superintendent. The benefit of this modification was that the vendors would be encouraged to assign their best personnel on the project. This also allowed the PPI process to be a better indicator of future performance, since information was being collected on the actual individuals being assigned to the project.

Minimizing the requirement to physically inspect all past projects

Prior to 2003, the PPI process required the client to physically inspect all roofing projects to document the physical deterioration and performance of each roof. The challenges with performing this function included:

- It required a substantial amount of effort from the client (to physically inspect all of the roofs)
- It required a substantial amount of effort from the vendor (to coordinate the inspections and assist with the inspection process)

- It required effort from past clients

In 2003, the PPI process was modified to allow the client the option to:

- Randomly inspect a minimum number of roofs
- Inspect only the roofs of the shortlisted firms
- Inspect only the roofs of the firm selected for award

This modification results in a more efficient process for both the client (since they were not inspecting every roof) and the vendor (especially if they were not selected for award).

Creating a standard survey questionnaire and minimizing the number of criteria

Prior to 2003, the PPI process allowed the client to create a unique survey for every critical area that would be evaluated on a project. This was done to allow each client an opportunity to have control over specific questions that would be asked. On average, each survey contained 37 different questions relating to the performance of the vendor. Some areas had up to 3 pages of criteria, such as mechanical systems that asked 79 unique questions.

A growing concern with allowing this process to continue was:

- The survey forms were becoming very long.
- Compiling the survey data required a substantial amount of resources from the client (to enter and double-check data)
- The process increased work for the vendors, since they would have to re-survey past clients if a new user had alternative questions to be evaluated.

In 2003, a statistical analysis was performed on over 200 contractor databases (Kashiwagi and Parmar 2004). The results of this study were significant. The study showed that using eight criteria generated the same statistical results as asking up to 79 different questions, notwithstanding what technical field was being surveyed. The results of the analysis concluded that a standard questionnaire could be asked to all construction trades, and that the number of criteria could be minimized to eight.

In 2004, the PIPS process was modified to use a standard questionnaire on all construction trades using the 8 criteria identified in the statistical analysis. The results of this modification:

- Survey forms were short and succinct (one page)
- The efforts of past clients were minimized (evaluating only 8 questions instead of a minimum of 37)
- Client resources were minimized (to compile and double-check the data)
- Vendors were not required to re-survey past clients (due to modified owner criteria)

The eight criteria are:

1. Ability to manage the project cost.
2. Ability to maintain the project schedule.
3. Quality of Workmanship.

4. Professionalism and ability to manage.
5. Close out process.
6. Communication, explanation of risk, and documentation.
7. Ability to follow the users rules, regulations, and requirements.
8. Overall customer satisfaction and hiring again based on performance.

Requiring the vendor to create and send out survey forms to past clients

Prior to 2003, the PPI process only required the vendors to prepare a list of past projects to be surveyed. Once the list was prepared and submitted to the Client, the Client would be responsible for:

- Creating a survey questionnaire for each reference for each vendor
- Faxing out the survey questionnaire to the past client
- Calling to confirm that the survey questionnaire was received by the past client

Although this process required the least amount of effort from the vendors, it resulted in a great deal of work on the client's side. The client was forced to spend an enormous amount of resources in preparing and faxing out all surveys for all vendors. They were also expected to call each past client to verify that they received the survey (to prevent a vendor from protesting that the client did not send out their surveys). Lastly, they had to designate resources to carefully document the survey process for each vendor.

In 2004, a decision was made to place the vendors at risk for sending out their own surveys. The risk with this decision would be a claim that this would require too much effort from the vendor. However, the benefits of doing this outweighed the potential risk. By requiring the vendor to send out their own survey, the following occurred:

- Vendors could not protest that the client did not send out their surveys
- The client was not at risk if the vendor did not send out their surveys
- The client did not having to document whether the past client received the survey
- The client saved a substantial amount of time and resources in the entire process

Current PPI Process

The current PPI process is shown in Figure 1 below. The process has 3 major steps, which will be discussed.

Step 1: The vendor prepares a reference list, which is a list of their best past projects. The vendors are instructed to not submit any low or bad projects. These projects do not have to be similar to the current project being procured. After the vendor prepares their reference list, they are required to send the list to the current client.

Step 2: The vendor prepares a survey questionnaire for each of their past clients. The vendor sends out the surveys to their past clients and requests that their previous clients return the survey to the current client as soon as possible.

Step 3: The current client prepares a database for each vendor. The database includes the reference list that the vendor submitted, and also contains the survey score responses from the past clients (the current client enters the survey data into the database). The current client then generates the vendors' average past performance score.

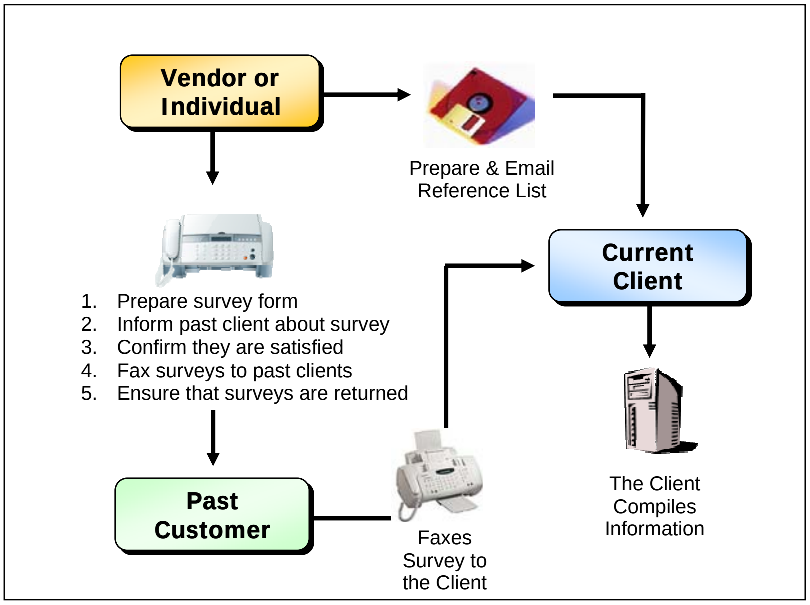

Figure 1: Current PPI Process

Although this process is more efficient than past processes, there are still potential improvements that can be made. The potential risks to the current system include:

- The overall score of each vendor may not be an accurate reflection of how well the firm performs (since the vendor is allowed to select only their best past projects)
- The process requires the vendors to spend resources in preparing and faxing out surveys
- The vendors do not know which past clients have turned in or submitted a survey.
- The process requires the client to spend resources tracking the surveys that have been returned and responding to the vendor's requests for information on surveys that have been submitted.
- The process requires the client to spend resources inputting all survey responses
- The process places the client at risk for accurately entering survey scores (which requires the client to double-check all entries)
- The vendor has no control if a past client gives them a low score

City of Peoria PPI Analysis

The City of Peoria has been using the PIPS Best-Value process since 2004. During this time, the City has collected over 5,000 surveys on: Construction Firms (76), Design Firms (81), and Key Individuals (515).

An analysis was conducted in 2008 on the time spent on the PPI process (Table 2). These numbers were based on the estimated amount of time spent during a one-year period from June 2007 to June 2008. This included:

- The total number of surveys completed for all contractors, designers, and individuals.
- The total number of invalid surveys, which includes the number of surveys that were received that did not correlate to any existing reference list
- The total number of vendor requests for PPI information. This includes the time to obtain survey information, and survey results for the firm and critical individuals.

Table 2

City of Peoria 2008 Analysis of Time Spent on the Past Performance Information (PPI) Process

No	Criteria	Number	Average Time / Entry	Total Time
1	Total number of surveys entered	2,742	10 min	457 hrs
2	Number of invalid surveys	2,664	5 min	222 hrs
3	Number of vendor requests for information	482	25 min	201 hrs
	Total Time Spent:			880 hrs

The results show that the City spent 880 hrs in compiling and maintaining the PPI databases over a one-year period. Assuming that the person entering all of this data makes $25/hr (including all overhead costs), this equates to approximately $22,000.

Modified PPI Process

To minimize the amount of resources needed to maintain the PPI databases, a modified process has been proposed. This process is similar to the current process, however, has a slight modification to increase efficiency. The process is shown below in Figure 2.

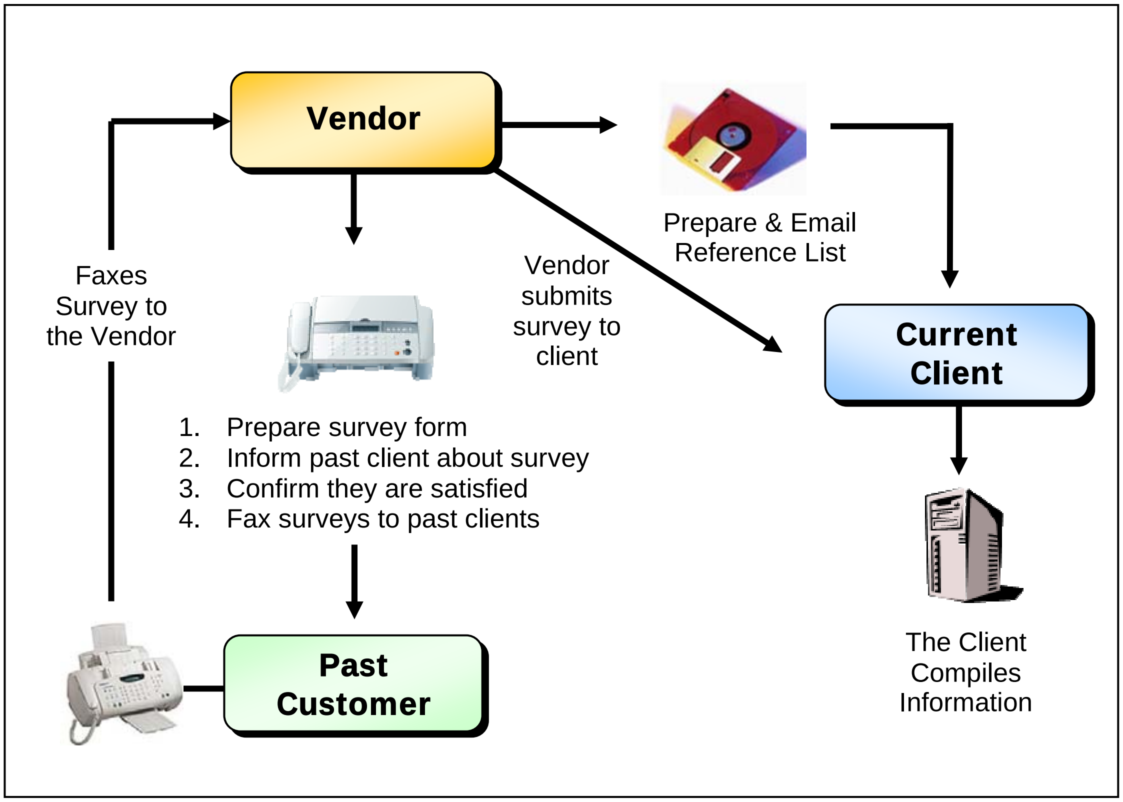

Figure 2: Modified Past Performance Information (PPI) Process

In the proposed modified system, the vendor becomes responsible for collecting all of their survey responses from their past clients (in the current system, the past clients return the survey directly to the current client). This modification has the following impacts:

1. The vendor knows who has / has not returned a survey. This will allow them to increase the number of returned surveys that they receive.
2. This may potentially increase the amount of work for the vendors (very minor increase), but various communications have indicated that the vendors are already having their past clients copy them on all survey scores.
3. The client should be able to reduce their efforts by 50% (they will not be needed to respond to request concerning returned surveys, and they will no longer need to investigate invalid surveys)

The potential risks to allowing this modification include:

1. The current client may fear that the vendor is altering or influencing the score.
2. The current client may fear that the vendor is disregarding bad surveys.

To minimize the potential risk of item 1 above, the modified system would require the past clients to sign each survey form, and the current client would reserve the right to randomly call any/all of the past clients to confirm their ratings. Any improper scores would result in penalties and/or disqualification.

To minimize the potential risk of item 2, the client would have to be educated that this risk is already a potential risk under the current system (since the vendors are instructed to only select their best scores). This may make it easier for a non-performer to get a better average rating, however, in the overall PIPS process, other factors should be used to prevent these vendors from proceeding.

University of Minnesota PPI Analysis

In 2005, the University of Minnesota began testing the PIPS best-value program. During the initial pilot testing, the University used the current PPI process. In February 2008, the University elected to test the modified system proposed above (since they were convinced that the other filters in the PIPS process would prevent a non-performer from proceeding to award). The results of both processes are shown in Table 3.

Table 3

Analysis of University of Minnesota Past Performance Information Processes

No	Criteria	Current PPI Process (2005)	Modified PPI Process (2008)
1	Number of Firms	41	23
2	Average PPI Score (1-10)	9.7	9.6
3	Standard Deviation of PPI Scores	0.4	0.4
4	Average Number of Surveys Returned	20	17
5	Response Rate (Percent of Surveys Returned)	78%	95%

The results indicate that the modified PPI process has very little deviation from the results of the traditional PPI process (used in 2005). The number of surveys returned, the average score, and the standard deviation were similar in both processes. However, the greatest differential was with the response rate. Under the modified system, vendors are responsible for receiving the surveys. This allows them to follow up and obtain a higher response rate. This process also minimized the client’s efforts in responding to vendor requests.

Future PPI Process

The modified process (currently being tested by the University of Minnesota) substantially increases the efficiency of the entire PPI process (for both the client and the vendor). However, the future may bring additional changes. Over the past 14 years, the PPI process has evolved.

Originally, the client assumed nearly all the risk of the PPI process. This included having the client responsible for creating survey forms, sending out surveys, calling the past clients to obtain a high response rate, receiving surveys, and compiling all of the data.

In an attempt to make the process more efficient, it was determined that the entity with the greatest, should be placed at risk. In this case, the vendor is at greatest risk for them obtaining an award or not. The process was modified to require the vendor to prepare and send out all surveys.

The proposed modification, which is currently being tested requires the vendor to also receive and collect all of their surveys.

The logical next step would require that the vendor be responsible for compiling their own database. This step would require a leap of faith by the client due to the obvious risk that the vendor may make up or alter performance scores into their database. However, in the bigger scheme of things, vendors that need to spend time attempting to cheat the most insignificant filter of the system will eventually be caught (by other filters in the PIPS process).

This future modification would greatly minimize all risk to the client (for collecting and maintaining PPI scores), and also provide a key tool for vendors (so they can truly understand their actual past performance).

Conclusion

Past performance information is a critical component for vendor evaluation, particularly for accountability, as current performance is always used to update and modify existing records of past performance. The optimization and implementation of past performance information use has been a long and arduous task, requiring numerous iterations, refinements, and hypothesis modifications. This paper presents a unique perspective as the results contained within are based upon actual iterations and projects, lessons learned, and enhancements made from the application of research concepts. Finding ways to minimize work while minimize risk is a difficult mandate for any researcher, and to date, the processes shown in this publication have been optimized to the greatest extent possible given the research results obtained. However, it is the anticipation of the authors that much refinement is still needed and will be incorporated as the future unfolds.

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Best-Value Process Implementation at the City of Peoria: Five Years of Research Testing

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The City of Peoria is Arizona's ninth largest city. It covers nearly 178 square miles and is home to over 153,000 residents. The projected 10 year growth of the City is estimated to be over 204,000, which has prompted a significant expansion of the City's municipal services and facilities. In an attempt to efficiently meet the demands of the projected growth, the City of Peoria partnered with the Performance Based Studies Research Group out of Arizona State University in 2004. The objective of the partnership was to test and implement a best value structure within the City's construction program, specifically as applicable to capital projects. This paper presents a five year summary of the test implementation results, the evolution of the best value structure within the city, project performance, service expansion to include non-construction projects, and lessons learned from the research. The research effort has included $385,691,802 in total projects awarded and implemented under the best value structure, with documented performance increases in cost metrics, schedule metrics, and customer satisfaction.

Keywords: organizational performance, best value, construction efficiency, design efficiency, risk management

Introduction

The City of Peoria is Arizona's ninth largest City. It covers nearly 178 square miles and is home to over 153,000 residents. The projected 10 year growth of the City is estimated to be over 204,000 which will prompt the significant expansion of the City's municipal services and facilities. The City of Peoria has taken steps to enhance development through revitalization plans to provide for further development of the central downtown area to support new and existing businesses as well as economic growth (City of Peoria, 2008).

As with many public organizations, the City of Peoria was required by law to award all competed projects to the lowest priced vendors. The results of these price-based projects fell far below the City's expectations (Sullivan et al, 2006). In May 2006, approximately 75 percent of the price-based projects were not completed on time, 75 percent had cost generated change orders, and the overall customer satisfaction was only 20 percent (Sullivan et al, 2006). Several projects had also gone to litigation over quality issues. The City was struggling to increase performance in a price-based environment.

In 2000, the State of Arizona passed H.B. 2340, which allowed agencies to use alternative project delivery methods to select construction firms (including design-build and construction-manager-at-risk). This allowed agencies to select vendors based on performance factors, rather than just price alone. The City of Peoria began to consider the value of their existing procurement system and investigating further options.

In 2004, the City of Peoria partnered with the Performance Based Studies Research Group (PBSRG) at Arizona State University (ASU) in order to implement a best-value procurement process. Through the system, the City hoped to identify and select higher performing vendors to increase the performance of their outsourced services.

The Performance Information Procurement System (PIPS)

The Performance Information Procurement System (PIPS) is a best-value selection, project delivery, and contract management tool that can be used to purchase any type of product or service. Since 1994, the PBSRG has researched and tested the PIPS process on hundreds of projects, resulting in extremely high customer satisfaction (98%) (Kashiwagi 2009).

The PIPS process provides clients with tools to assist them in making an informed decision based on performance information (and not solely on price or marketing information). The process not only assists in selecting a high performing vendor, but also has a mechanism to document and manage the vendor/service during the project. This tool has proven to be just as valuable as the selection process itself (Sullivan et. al 2007).

The PIPS process has seven major steps that are used to procure and manage high performing vendors, which are outlined below:

1. Vendors and their critical individuals are required to collect performance ratings on projects that they have completed in the past. The surveys (from their past clients) are averaged together to obtain a “past performance information” score. These scores are used later in the selection process.
2. The second step requires that the contractors submit a two-page Risk Assessment and Value Added (RAVA) Plan on the project being procured. This document provides the vendors with the opportunity to differentiate themselves from their competitors in terms of value and expertise, justifying to the client that they are not a commodity. A key aspect of this step is the “blind” evaluation of the RAVA Plans by a committee. During the evaluation process, all company names are withheld in order to eliminate bias and rate solely on performance.
3. The third step consists of identifying the top three firms and interviewing the critical individuals that would actually be involved in the project. This allows each option to be realistically compared, potentially disqualifying a vendor if the critical individuals are changed. A standard set of questions are asked to each firm and their responses were documented.
4. The fourth step in the process includes using decision making models to analyze and compare all of the data and evaluation scores.
5. The fifth step involves identifying the best value option and providing time for the potential vendor to carefully pre-plan the entire project to ensure that they have not missed anything. Both the owner and vendor must be satisfied with the plan before the contract is signed. This period of time is called the pre-award phase.

6. After award is made, the vendor is then required to submit a weekly risk report that outlines any issues that develop during a project with a probability of affecting time, money, or quality (owner satisfaction). These reports are standardized and are due every week (Friday) until the project is complete. These reports provide the client with a documented overview of the development of all project deviations.
7. Once the project is complete, the last step involves evaluating the performance of the vendor on the project. This rating accounts for 50 percent of their "past performance information" score (which places them at risk to perform on this project or jeopardize their competiveness on future best-value projects).

The PIPS process has been implemented by many different clients in both the private and public sectors (by Local, State, and Federal agencies). Due to the rules and regulations of each client, the PIPS process is easily adapted and tailored to meet the constraints of each user. Clients have used the system on construction projects ranging from under $10,000 to over $100 Million, as well as non-construction service contracts that have exceeded over one billion dollars. Under the State of Arizona procurement codes, the City of Peoria was allowed to use the PIPS process under the Design-Build (DB) and Construction Manager at Risk (CMAR) delivery processes. However, State law prohibited the City from asking for or considering project costs. This meant that the City could only review performance information, without any consideration for price or fee. The impact of this law will be discussed later in this paper. A summary of the City's proposal process is shown in Table 1.

Table 1

Proposal Process for the City of Peoria

No	Criteria	Traditional RFP Process	Best-Value RFP Process
1	Past Performance Information	3 References were required. City called to verify performance (Pass/Fail)	All critical areas were surveyed (up to 25 projects) (Scores used in selection)
2	Proposal Document	20-Page Proposal (mostly consisted of general marketing material)	2-Page Risk Assessment and Value Added Plan (specific to the project being procured)
3	Interview Process	Group Interview (resulted in a marketing presentation)	Individual Interview of Key Personnel
4	Pre Award Phase	None Required	Pre Planning Required Before Award
5	Project Reporting	Vendors would generate upon request	Required Every Week. All reports are standardized.

Best Value Research Results

The City of Peoria has implemented the PIPS best-value process on 55 projects, over $389 Million in contract value. The City initially implemented the process on construction projects, but after documenting the performance results, they expanded the use to Architectural and Engineering services, and service-type projects (such as emergency radio services, landscaping, and software services). Table 2 illustrates the City's distribution of the best-value projects.

Table 2

Summary of City of Peoria's Use of the PIPS Best-Value Process

No	Criteria	Number of Projects	Size of Projects
1	Construction Projects	36	$365,595,962
2	Architectural & Design Projects	14	$5,221,619
3	Service Projects	5	$14,874,221
	Total	55	$385,691,802

Due to the large size of the projects, many of the projects are still in progress or on-going services. Ten projects have been completed and the performance of these projects are documented in Table 3. The table also provides a baseline performance measurement of 38 traditional price-based projects that were also completed at the City (Zenko, 2009).

The overall change order rate was reduced by 99% by going from the traditional price-based award to the best-value award. The overall project delay rate was reduced by 77%. The overall customer satisfaction rates were increased by 395%. These numbers are impressive due to the large size of the projects (over $193 Million).

Table 3

Analysis of Completed Best-Value Projects versus Traditional Price-Based Projects

No	Criteria	Unit	Price-Based Projects	Best-Value Projects
1	Total Awarded Cost	$	$74,181,566	$193,416,201
2	Total Final Project Cost	$	$79,315,696	$193,586,738
3	Change Order Rate	%	6.9%	0.1%
4	Total Awarded Project Duration	Days	6,016	3,595
5	Total Final Project Duration	Days	8,135	3,891
6	Delay Rate	%	35.2%	8.2%
7	Overall Customer Satisfaction	%	20%	99%
8	Total Number of Completed Projects	#	38	10

Case Studies

The first PIPS Best-Value Project at the City of Peoria was the Rio Vista Project. This project was procured under the design-build delivery method, and consisted of designing and building a recreational park with seven baseball fields and a 51,736SF recreational facility. Seven teams submitted proposals for the project. The City identified the best value selection as the firm who performed the highest based on the owner's selection criteria. This project was awarded for $20 Million but was completed for $19.4 Million (the contractor was able to return money back to the City). The project met the City's expectation and was awarded the Construction Owners of America Top Gold Award for Project Leadership in 2007.

The Fire Station #7 project was an excellent case study of the impact of using the PIPS process for both the design and construction services. The selected design team and the construction firm scored the highest in interviews and RAVA Plans. The vendors were able to successfully partner to make the $3 Million project a success. Similar to the Rio Vista Project, the contractor was able to complete the project under the awarded fee, and was able to return money back to the City. This project won several awards including the Gold Medal Design Excellence Award from Fire Chief Magazine in 2007, and the Design Excellence Merit Award from Fire Rescue Magazine in 2007.

Summary of Selection Factors

Due to the Arizona Procurement code, the City of Peoria was prohibited from requesting project costs/fees from vendors on best-value projects. The selection process was based strictly on performance measurements. To assist the vendors in improving their competitiveness, the project information available was analyzed to determine the factors that contributed to the best-value vendor or team being selected.

The City shortlisted vendors prior to interviewing to minimize the resources required from both the City and from the non-competitive vendors. This was done on the majority of projects where the City received more than three proposals. An analysis of 15 shortlisted projects indicates that the vendors that were shortlisted had 18% higher RAVA Plan ratings and also had 6% higher PPI scores (See Table 4).

Table 4

Analysis of Shortlisted Vendors vs Non-Shortlisted Vendors

No	Criteria	Shortlisted Vendors	Non-Shortlisted Vendors
1	RAVA Plan Rating (1-10)	6.6	5.4
2	Past Performance Rating (1-10)	9.3	8.7
3	Number of Returned Surveys (#)	9	6

An analysis of 28 final selection models indicates that the awarded best-valued vendor had a 15% higher interview rating than the non-awarded vendors. A comparison of the RAVA Plan scores, and PPI scores indicates that there is very little differential between the firms. From this, it can be concluded that while the RAVA Plan and PPI are important factors in being shortlisted, the interview phase is the most important in determining the best-value award.

Table 5

Analysis of Awarded Vendors vs Non-Awarded Shortlisted Vendors

No	Criteria	Awarded Vendors	Non-Awarded Vendors
1	Interview Rating (1-10)	8.2	7.0
2	RAVA Plan Rating (1-10)	6.8	6.3
3	Past Performance Rating (1-10)	9.5	9.2
4	Number of Returned Surveys (#)	10	9

Impact of Not Reviewing Cost Proposals

Due to the Arizona Procurement code (ARS, 2000), the City of Peoria was prohibited from asking for project costs/fees from vendors on best-value projects. The lack of this critical information made it difficult to justify that the City was truly receiving the best value for their money. This is illustrated by the comparison of the originally estimated budget of the project, to the final awarded cost of each project. Out of the 10 completed projects, the original estimated budget was $140 Million. The awarded cost of these projects was $193 Million, which is 38% higher than the estimated budget. Once again, it is unclear whether the original budget was inaccurate or not (since the City was not allowed to ask for costs from any of the competitors). However, it is clear that there was a significant increase in the performance of these projects with regards to cost increases, project delays, and overall customer satisfaction. It is also important to note that on 50% of the completed projects, the vendors actually returned money back to the City (since they were able to complete the project under their originally estimated fee).

Important Research Developments

Throughout the five-year research program, the City has tested and developed alternate procedures to steps within the PIPS best-value program. The key developments are discussed below:

1. RAVA Plan Template (2005)
   When the City first began implementing the PIPS process, there was no standard risk assessment and value added (RAVA) Plan template or format. Vendors were allowed to create and format their own RAVA Plans. This resulted in Plans with colors, pictures, alternate font sizes, and alternate page margins. After procuring several projects, the City realized that they could begin to identify which RAVA Plans belonged to which vendors (even though the plans had no names in them). The City requested that a RAVA Plan template be created so that all of the RAVA Plans looked visually the same (to minimize evaluator bias).

2. RAVA Plan Page Limit (2005)
Due to the large size of the City's projects, the City requested that vendors be allowed to submit up to 5 pages on their RAVA Plans (instead of the 2-page limit). This modification was made and tested on 7 projects. The results were compared to 4 projects that only allowed 2 pages. The research showed that by increasing the page limit from 2-pages to 5-pages, no additional value was generated (Table 6). The additional pages resulted in additional marketing material which had no value to the individual projects. Since then, the City has returned to the 2-page RAVA Plan limit on all of their projects.

Table 6

Analysis of 5-pages vs 2-page RAVA Plans

No	Criteria	Phase I (5-pages)	Phase II (2-pages)
1	Number of Projects	7	4
2	Total number of RAVA Plans submitted	40	30
3	Average number of RAVA Plans submitted	6	8
4	Average number shortlisted	3	3
5	Overall average score (1-10)	6.3	6.4
6	Standard deviation	0.9	1.0
7	Average rating – shortlisted firms	6.7	6.9
8	Average rating – non-shortlisted firms	5.8	5.9
9	Difference (shortlisted vs non-shortlisted)	0.9	1.1
10	Total number of risks	552	181
11	Percent of risks that were considered general risks	75%	62%
12	Percent of risks that were considered specific risks	24%	38%
13	Percent that identified budget as a risk	8%	13%
14	Percent that identified schedule as a risk	11%	3%
15	Percent of plans with marketing information	59%	33%

3. Past Performance Information Modification (2009)
The collection and use of Past Performance Information has undergone significant changes. When the City first began the process, Vendors were required to send surveys to their past clients, and the past clients were required to return the surveys directly back to the City of Peoria. Over 7,000 surveys had been collected, which required a significant amount of resources from the City to monitor and track. This also made it difficult for the vendors to know which past clients had returned a survey (in order to increase their response rate), and made it difficult for the vendors to know their actual scores. In 2009, the City modified the PPI process to allow vendors the opportunity to collect their own surveys. This made the process easier for the vendors, and minimized the amount of resources required from the City to manage the process.

Lessons Learned

Throughout the City's five-year best-value program research, several key lessons learned have been documented.

Continuous Education of Core Group. The difference between this organization and many that have failed to implement the Best Value PIPS approach is the continual proactive education of the core group. The procurement department has received numerous education and training sessions, attended yearly best-value conferences, and also enrolled in several of the best-value Master's Degree courses at ASU.

Go Slow and Document the Results. One of the greatest challenges with implementing the PIPS best-value process is the speed of implementation. The PBSRG recommends testing pilot projects that are small, simple, and can be completed within a short time frame (less than one year). This allows the client time to learn the basic steps of the process and document whether the process can work for the user or not. The City of Peoria was unable to run their pilot projects in this manner. Their capital improvement projects were all large in scope and took over 1-year to complete. This made it difficult to provide dominant information that the program was improving the City's processes. Although the program has been a significant success, the City did run into some issues that jeopardized the future success of the program (discussed in next section).

Avoid Highly Political Areas. Due to the success of the construction implementations, the City expanded the use of the PIPS program to Architectural and Engineering services. The first few A/E projects were successful; however, a small group of engineers began challenging the process. These vendors claimed that the process was unfair since they were not winning any projects. Through political pressure, the vendors were able to force the procurement department to stop using the PIPS process (on A/E services). Without dominant information of documented successes, the City was unable to continue the use of A/E services. In 2008, the procurement department was able to provide the documentation performance results to the newly elected City Mayor. The information provided enough dominant information to reinstate the use of PIPS on A/E services. The lesson learned from this instance, is that in order to effectively use time and resources, highly political areas should be approached with caution. They should only be attempted after great consideration has been made and careful documentation is available to provide proper support.

Interview of Key Personnel. In the past, the City traditionally had an interview period, but it was treated as more of a presentation period, where the vendor would provide a presentation of past projects they had completed. This resulted in a marketing presentation, in many cases presented by marketing personnel. When the City implemented the PIPS best-value process, a major differential was that the vendors key personnel were actually interviewed. No marketing or upper management personnel were permitted to sit in the interviews. The City realized the importance of conducting interviews with key personnel after several firms were represented by individuals stating that they had, "no idea what the project they were interviewing for consisted of," or, "why their firm had sent them," to the interview. The City took this concept one step further by interviewing additional personnel besides the Site Superintendent and Project

Manager. The City interviewed estimators and pre-construction personnel, which provided valuable information on CMAR and DB projects.

Importance of the Weekly Risk Reporting System. When the City of Peoria first began using the PIPS process, there was no standardized reporting system. In 2007, a standardized Weekly Risk Reporting System was created to assist clients in monitoring and tracking the performance of their projects. This system allowed the vendor to document all risks that developed throughout a project that impacted project duration and project cost. This information is critical to have, as it provides a standardized method of documentation that identifies who or what generated the risk and what actions were taken to minimize, or exacerbate, the risk.

The advantages of this tool are clear when considering previous Table 3. While the table shows that the completed projects have an overall change order rate of 0.1% and an overall project delay rate of 8.2%, it is not clear who or what caused the schedule and budget deviations. Without the weekly risk report, the cause of the changes would be unclear (owner, designer, or contractor generated), as well as the type of risk (simple scope change, contractor mistake, design error, etc). It allows all parties to be held accountable for their actions or lack of action. The Weekly Risk Reporting System template provides the client with a simple report to monitor and track their projects. This report has since been included in all recently award projects at the City.

Conclusion

The implementation and testing of a best value procurement, project delivery, and contract management structure at the City of Peoria has yielded many positive and useful results:

1. The research has shown, that despite price not been a factor in the procurement process, a high performing firm can still be selected, though the value of that firm is unknowable.

2. Despite not fully and correctly implementing all aspects of the best value system, specifically, failure to completely incorporate the pre-planning and weekly risk reporting processes, project performance has still increased.

3. Inefficiency is a business process and structural issue, not a technical issue. This has been shown via the successful application of the best value structure to construction (under three different delivery systems), A/E services, and several non-construction services all being improved over prior performance. The only modification was a move from a technical focus for risk mitigation, to a process and outsourcing focus for risk mitigation.

4. Education is critical to sustained change and successful adoption of a new process.

The research effort is still underway at the City of Peoria with more tests, new methods, and different types of projects be run under the best value process.

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The Dutch Construction Industry: An Overview and Its Use of Performance Information

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This paper gives an overview of the Dutch Construction industry and elaborates further on its use of performance information. After giving an overview of the Dutch construction industry depicting size, major contractors, growth, profitability, value added, costs, productivity, this section is concluded by giving future predictions of the industry for the following years. A summary is given of the 2002 Dutch construction collusion as a means to give explanations for the persistent use of procurement based on lowest-bid competition. Although a starting realization is recognizable towards more innovative ways of tendering to restore trust and bilateral relationships between constructors and their clients; change is slow as hard data of performance information is limited. Current available performance information of the Dutch construction industry is discussed, such as failure rate and costs, bottlenecks, procurement methods used, customer satisfaction and selection criteria. As seen throughout this paper, innovative ways of procurement can contribute to the changes aspired to by the Dutch construction industry as well as bring in added value. Government plays a central role as a major client and frontrunner and also with the means of regulating policy on procurement for the industry. Although new initiatives of change towards more innovative ways of tendering are starting to build with cooperation between companies and industry platforms, it remains still in its infancy.

Keywords: Construction industry, Dutch, Performance information

Introduction

The dominant form of acquiring resources in the construction industry is still the transactional exchange (Dubois & Gadde, 2000; Thompson et al, 1998), with a reliance on tendering procedures. Procurement through tendering procedures essentially revolves around inviting project offers and selecting the most suitable one (Duren & Dorée, 2008).

Dubois & Gadde (2000) propose a shift in the construction industry from a coordination of projects to coordination amongst firms. Studies of customer-supplier collaboration, in general, have shown that major benefits may be achieved when firms make adaptations to one another (Hines, 1994; Spekman et al., 1999). Three main types of adaptation may be distinguished (Gadde and Hakansson, 1994): technical adaptations - connecting the production operations of supplier and customer; administrative routines and knowledge-based adaptations.

Beach et al. (2005) argue that the tendency to use fewer subcontractors will continue; 77% of their respondents indicated that they had reduced the number of suppliers they used while 57% had plans to reduce the total number of subcontractors and favour ‘partnered’ subcontractors in the future. Beach et al. also argue that the concept of “best value” is of importance. Best value can be drawn out of a project by utilising the specialist knowledge and expertise (thus the resources) of suppliers. Doing so can prevent problems, reduce programme complexity, durations and costs, and improve the overall quality of the project (Beach et al., 2005).

Saad et al. (2002) concluded that there is significant awareness of the importance of supply chain management and its main benefits in construction. It can help construction overcome its fragmentation and adversarial culture, improve its relationships and better integrate its processes. PIPS (Performance Information Procurement System) is a procurement method which incorporates these benefits and aims to select the most suitable contractor for the job, to spur this contractor on to highest performance, as well to reduce the client’s management and control tasks (Kashiwagi, 2004).

The public sector and the Dutch construction industry could potentially benefit hugely implementing innovative procurement methods such as PIPS. However, resistance to change seems to dominate the Dutch procurement and tendering procedures. Most projects (over 80% of the Dutch construction industry) are still being tendered in the traditional manner; design, bid, and make selection according to lowest bid (Duren & Dorée, 2008). This is also demonstrated by the sparse use of quality related criteria in procurement (Boes and Dorée, 2008).

PIPS moves away from the culture where relationships based solely on market forces are often distrustful, if not antagonistic, and rooted in the fear that the other party might engage in opportunistic behaviour (Johnston & Lawrence, 1998). This fear of opportunistic behaviour turned out to be legitimate in the Netherlands. In 2002, allegations of unethically opportunistic behaviour were being made of bid rigging, collusion and corruption within the Dutch construction industry. A Parliamentary Committee was formed to research the allegations. The Dutch construction collusion was a black episode in the history of the industry and had enormous impact on trust and future interactions between public sector clients and contractors.

This paper aims to describe the changes, within the context of the aftermath of the Dutch construction collusion, towards more innovative procurements procedures in the Dutch construction industry and its current use of performance information. In the first part of this paper a sample overview of the total available information on the Dutch construction industry is given. In the second part, we will describe our desk-research within the context of the above introduction and further elaborate on the use of performance information within the Dutch construction industry.

Statistical information is gathered and processed by the Economisch Instituut voor Bouwnijverheid (EIB; Economic Institute of the Buildingindustry) and Centraal Bureau voor de Statistiek (CBS; Central Bureau of Statistics Netherlands). Industry groups as PSIBouw, PIANOo and Regieraad Bouw provide more qualitative information on the industry.

Overview of the Dutch Construction Industry

Number of companies and employees

The Dutch construction industry is a highly fragmented market. Since 2000 the number of companies has been increasing from 63380 to 96660 in 2008; an increase of over 52% in 9 years time. However, as shown in Table 1, the number of employees (and FTE) in the Dutch construction sector remains fairly stable with an average of 474 thousand employees.

Table 1

Number of Dutch Construction Companies and Number of Employees

Periods	Number of companies	Total employees (absolute x 1000)	Total FTE (absolute x 1000)
2000	63380	474	449
2001	67595	485	455
2002	69440	481	456
2003	71295	472	444
2004	72365	460	430
2005	74025	462	434
2006	81690	484	452
2007	85910	-	-
2008	96660	-	-

Note. Source: EIB 2007; CBS, 2007

The increase of total construction companies can be explained by the entry of companies with only 1 or 2 employees as freelance construction workers (see Table 2) who started their own business. These companies make up almost 80% of the total companies in the Dutch construction industry. The fact that the number of total employees in the industry remains stable is the result of the decrease of the total number of all companies larger than 2 employees.

Table 2

Total Number of Companies and Number of Employees Over 2007, 2008

	1 Januari 2007	1 Januari 2008
Total number of companies	85910	96660
1 employee	53320	64395
2 employees	11565	11875
3 to 5 employees	6405	6565
5 to 10 employees	6385	6015
10 to 20 employees	4295	4085
20 to 50 employees	2865	2700
50 to 100 employees	645	620
100 or more employees	430	405

Note. Source: CBS, 2009

Construction companies in the Netherlands larger than 50 employees make up only just over 1% in 2008 (see Figure 1). The vast majority of construction companies in the Netherlands are medium in size or small.

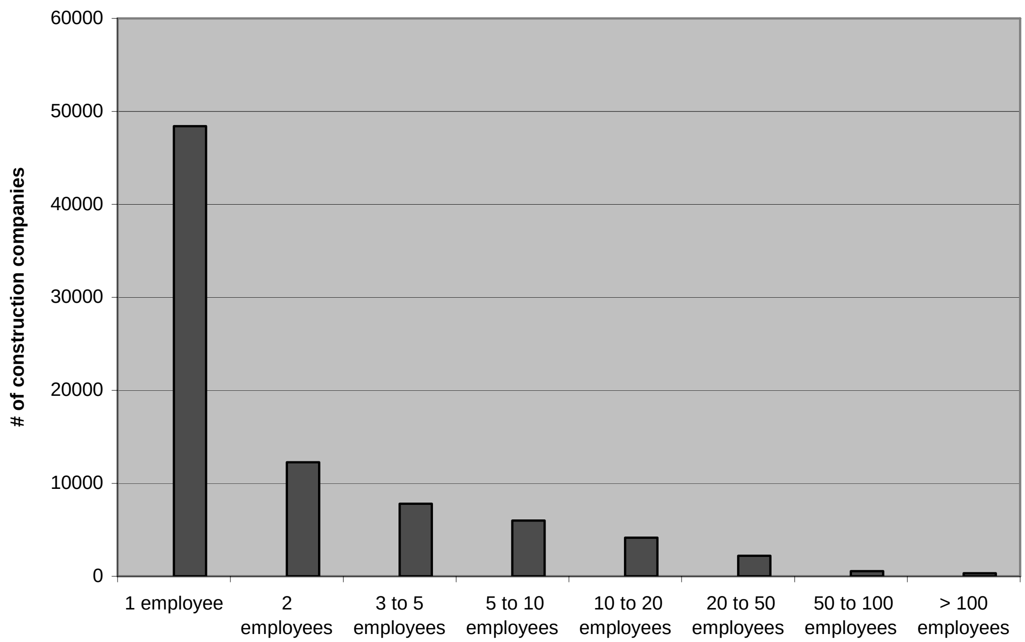

Figure 1: Number of construction firms according to number of employees. Source: CBS Statline 2006

Although the vast majority of the construction market consists of small companies, almost a third of market share can be attributed to only the ten largest construction companies.

Major contractors

The 10 largest Dutch construction companies are listed in Table 3, showing total turnover, net results over 2008, their domestic position in 2007 and 2008 and their European position in the top 100. Their joint turnover is about €29 billion, roughly a third of the € 84 billion Dutch construction industry (as at 2008).

Table 3

Top 10 Dutch Construction Companies

Domestic position in 2008	Domestic position in 2007	Company name	Position in Europa	Turnover 2008 (in million Euro)	Net result 2008 (in million Euro)
1	1	Koninklijke BAM Groep NV	9	8.835	161,9
2	2	Koninklijke Volker Wessels Stevin NV	18	5.393	142
3	3	Heijmans NV	22	3.630	-56,8
4	6	Koninklijke Boskalis Westminster NV	41	2.094	249,1
5	4	TBI Holdings NV	44	2.404	47,8
6	5	Van Oord NV	45	1.896	190
7	7	Ballast Nedam NV	59	1.426	24
8	9	Strukton Groep NV	66	1.249	14,3
9	8	Dura Vermeer Groep NV	68	1.132	7,5
10	10	Koop Holding Europe	91	-	-

Source: Deloitte, 2009; annual reports of construction companies

When comparing the Dutch construction industry and its 10 largest players to the other European construction industries, we can conclude that the Dutch companies are rather dominantly present in the top 100 of largest European construction companies. With one construction company, in the top 10 (BAM Group NV at number 9) and with a total number of 10 Dutch construction companies in the overall 100 largest European construction companies, only Spain and the United Kingdom have a larger market presence in Europe (Deloitte, 2009).

Construction industry growth

In 2003, the turnover of the Dutch construction industry amounted to almost €67 billion and €4,4 billion (6,6% of turnover) in Earnings Before Interest and Tax (EBIT), growing to over €70 billion in turnover and €4,5 billion EBIT (6,4% of turnover) in 2005 (EIB, 2006). Figure 2 shows the growth in the Dutch construction industry in more recent years (CBS, 2008). Until 2005, the Dutch construction industry accounted for about €67 billion turnover on a yearly basis. After an initial drop of over 4% in growth in the first quarter of 2005, the second quarter received an increase of 6,9%. This turned out to be the largest increase of turnover in the Dutch construction industry since September 2003 (De Gelderlander/ANP in Bouwweb, 2005).

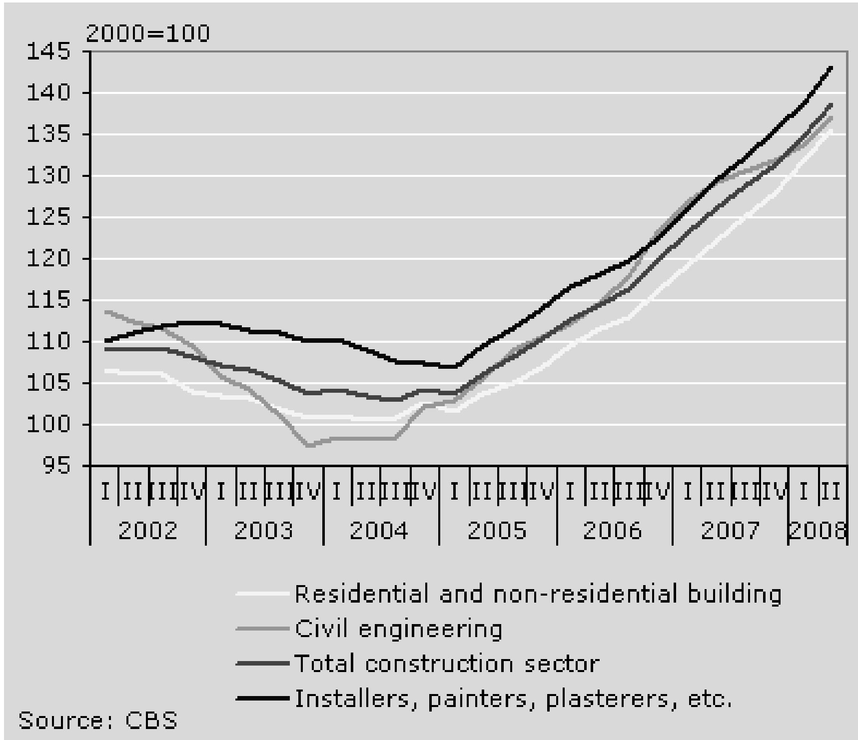

Figure 2: Turnover growth Dutch construction sector; 12 monthly moving average (CBS, 2008)

A consistent increase of yearly turnover continued from the second quarter of 2005 to the first quarter of 2008. This steady growth resulted in an increase of 26% within 3 years time and a total turnover in 2008 of an estimated €84.4 billion. The turnover-uprising comes to a grinding halt in October 2008 with the start of the worldwide financial crisis.

Table 4 and Table 5 show the size of the Dutch construction industry from a GDP perspective. Table 4 shows that the construction industry contributes a consistent yearly average of 5% to the GDP. Of this total average of 5%, about 2% is accounted for by the sector of construction of buildings, 1% by civil engineering and about 2% by the building of installations and completions.

Table 4

Value Added (Gross, Basic Prices) by Industry and Sector: % GDP

	1995	**1996**	**1997**	**1998**	**1999**	**2000**
Construction	4,9	4,8	4,7	4,8	4,9	5,0
Construction of buildings	2,1	2,0	1,9	1,9	2,0	2,0
Civil engineering	1,0	1,0	1,0	1,0	1,0	1,0
Building installation and completion	1,9	1,9	1,8	1,9	2,0	2,0
Value added (gross, basic prices)	90,3	89,8	89,6	89,4	89,2	89,3
Value added (gross, total industries)	305 261	319 755	342 237	362 464	386 193	417 960
	2001	**2002**	**2003**	**2004**	**2005**	**2006**
Construction	5,1	5,1	4,9	4,8	4,8	4,9
Construction of buildings	2,0	2,0	2,0	2,0	2,1	2,1
Civil engineering	1,1	1,0	0,9	0,8	0,8	0,9
Building installation and completion	2,1	2,1	2,0	1,9	1,9	1,9
Value added (gross, basic prices)	88,8	89,1	89,2	88,9	88,8	88,6
Value added (gross, total industries)	447 731	465 214	476 945	491 184	508 964	534 324

Note. EIB, 2006

With a consistent growth of about 3% yearly, the Gross Value Added stood at almost 12,5 billion in 1989 and grew to well over €26 billion in 2006 (Table 5); an increase of 52% in 18 years. The only down-turn in Gross Value Added of the total Dutch construction industry can be seen from 2002 to 2005 and coincidentally (?) parallels with the aftermath of the Dutch construction collusion.

Table 5

Gross Value Added: mln euro

	1989	1990	1991	1992	1993	1994	1995	1996	1997
Construction	12493	12794	13225	13909	14209	14685	14924	15356	16147
Construction of buildings	5786	5740	5833	6092	5981	6 340	6400	6325	6560
Civil engineering	2034	2186	2310	2376	2723	2923	2881	3106	3301
Building installation and completion	4673	4868	5082	5441	5505	5422	5643	5925	6286
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Construction	17238	19044	20891	22672	23698	23557	23468	24406	26249
Construction of buildings	6853	7580	8294	8730	9266	9 507	10029	10594	11359
Civil engineering	3445	3866	4212	4698	4655	4351	4084	4 072	4552
Building installation and completion	6940	7598	8385	9244	9777	9699	9355	9740	10338

Note. EIB, 2006

Labour safety and productivity

Since the early 1970’s the labour safety in the Dutch construction industry has gone up considerably with the number of incidents per 100 man-years down to only an average of six (see Figure 3)

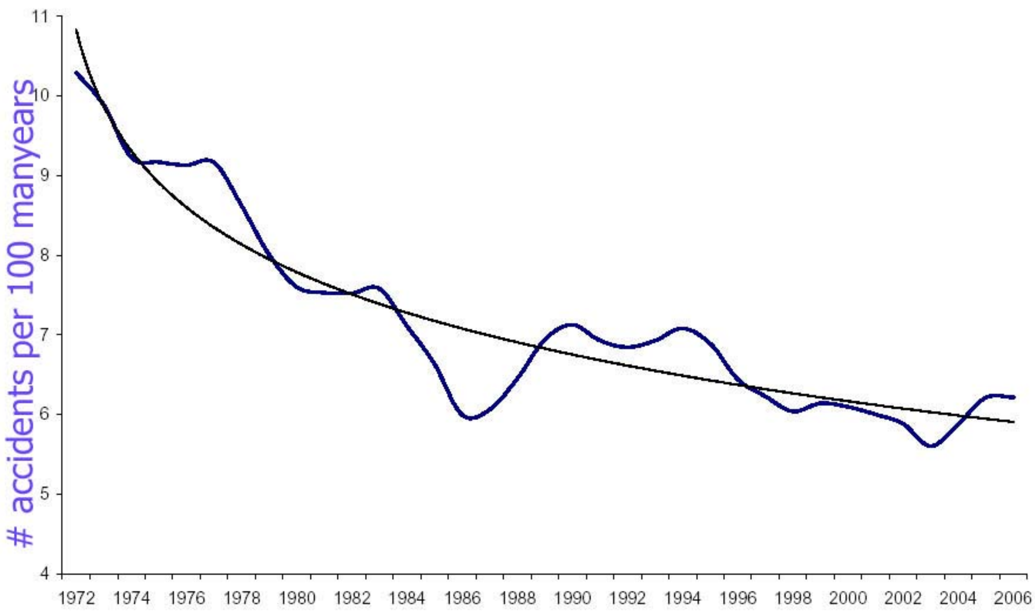

Figure 3: Number of incidents with absence per 100 man-years period 1972-2006 (only personnel on construction site), (Arbouw, 2006).

In 2008, the Dutch construction industry had the highest EU-25 personnel costs, with an average yearly salary of 45.000 euro per employee. Only €600 lower than Norway, which is not a EU member state, which had the highest average personnel costs in the world (Bouwtrefpunt, 2008).

The increase of personnel costs from 2003 to 2005 had an average increase of only 2,2% over 5 years.

Future predictions for the Dutch construction industry

As a result of the financial crisis which started in October of 2008, the next 3 years look rather grim for the Dutch construction industry according to the EIB (See Figure 4). In 2009 and 2010 the construction industry growth will decline with -5,5% in 2009 and -9% in 2010. With a staggering -15% decrease of output, about 50.000 jobs will be lost. Most likely companies with only one or two employees will be the most severely effected. Also in 2011 it is predicted that construction production will still be down by -0,5%. The construction industry will only stabilise and recover during the year 2012. Although an average yearly production growth of 3% in the years 2011-2014 is predicted, the level of output at the end of 2014 will still be likely to remain under the level of 2008.

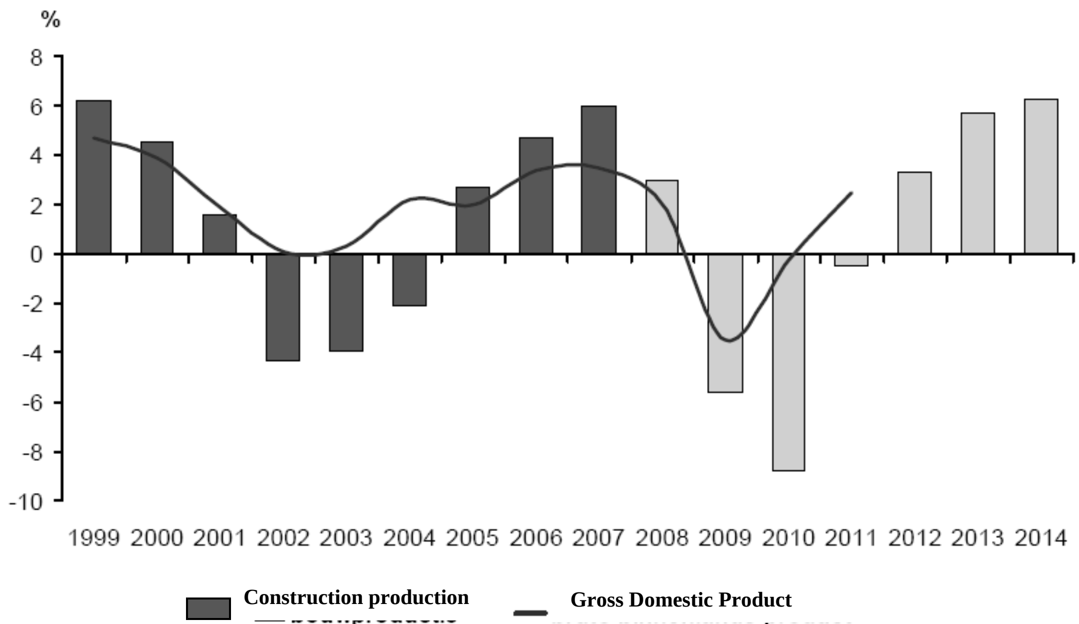

Figure 4: Future growth predictions of the Dutch construction industry (EIB, 2009)

Collusion in the Dutch construction industry

To fully understand the current Dutch construction industry dilemma of ‘willingness’ versus ‘resistance to change’ towards more innovative ways of procurement; we should shortly review the history of the Dutch construction collusion and its impact on the industry and its current state.

In 2002, the procurement of construction work in the public sector became a major issue in the Netherlands after a media documentary had suggested that the tax payer was yearly robbed of about €500 million through collusive behavior, bid rigging, and corrupt practices among construction companies and civil servants. After the largest invasion in Dutch legal history, the

Parliamentary Inquiry Committee publicly questioned around 45 people. Investigations focused predominantly on national public clients, however Ferguson et al. (1995) notes that client-contractor relationships were also often recurrent among Dutch municipalities. Only 2-3% of projects saw the formation of new client-contractor relationships (Dorée, 1997). The high rate of recurrent contracts in local procurement practice was suspected to be the result of over close relationships, which were vulnerable to corruption and collusion.

The final report drafted by the Parliamentary Inquiry Committee did not substantiate the earlier allegations of corruption, however confirmed the structural nature of cartels and bid rigging. It was also concluded that the government had neglected its responsibilities and had failed to draft a consistent policy for the construction industry (Dorée, 2004). Although claims of excess profitability on the part of the contractors were not substantiated, the existence of cartels and bid rigging were never denied by the associations of contractors.

The investigations and allegations have had a major impact on trust, and the relationship between public sector clients and the construction industry (Dorée, 2004). As a response, the Netherlands' Parliamentary Inquiry Committee on construction collusion adopted the guiding principle of 'competition is good' and urged the restoration of the proper functioning of the market (Dorée, 2004). Since 2002 the proposed default approach to public sector procurement has been selection of the lowest price. As Dorée (2004) concludes; a tougher public sector procurement policy and the continued reliance on lowest bid prices may not contribute to the reform of the Dutch construction industry as intended.

Performance Information in the Dutch construction industry

Performance information and past performance is a current topic within the Dutch construction industry. A logical effect of the heavy 'lowest-bid' competition institutionalised by the Parliamentary Committee after the construction collusion. There is much discussion on how to tender on different criteria than only price. Not surprisingly, when looking at the major bottlenecks (see Table 6) in the construction sector of buildings and civil engineering, according to the construction companies themselves, the number one bottleneck is the 'heavy competition on price'.

Table 6

Top Five of Most Mentioned Bottlenecks per Sector in 2006

	Bottleneck sector construction of buildings			**Bottlenecks sector civil engineering**	
		Mentioned by companies %			**Mentioned by companies %**
1.	Heavy competition on price	74	1	Heavy competition on price	80
2.	Rules & regulation	67	2	Administrative burden	69
3.	Permission policy	67	3	High labor costs	63
4.	Administrative burden	65	4	Delivery systems policy	63
5.	High labor costs	62	5	Rules & regulation	59

Note. Source: EIB; 2006

A growing number of publications show that there is a great potential to increase the quality of tender processes and project results. Many publications promote integrated project delivery schemes (e.g., turn-key and design-build), and propose selection on quality-based criteria rather than just low-bid (Barret, 2007; Courtney, 2004). Another trend involves the consideration of past performance as a selection parameter (Duren & Dorée, 2008).

In a PIPS tender both variables are being considered. PIPS can be described as a predominantly information-based system which can make predictions about expected result based on performance (Duren & Dorée, 2008). Contractors appear to embrace the challenge to find clever solutions as a way of distinguishing themselves. Within a PIPS tender, then, contractors compete on quality in addition to costs, which contributes to the professionalization of the construction industry. In addition, PIPS creates an environment that focuses and encourages the alignment of goals and gives a real boost to cooperation (Duren & Dorée, 2008). Therefore the application of PIPS by clients should make the problem of heavily competing on price less important as ‘quality’ is the distinguishable criterion, albeit only to notice for the competent construction firms.

Costs of failure

Failure costs of projects are large in the Dutch construction industry. A growing awareness is starting to dawn in the Dutch construction industry that the old methods have to be discarded and new, more innovative and effective ways have to be adopted to restore trust and bilateral relationships between constructors, their suppliers and their clients. Especially after the events of 2002 of the Dutch construction collusion.

The cost of failure rate was 7.7% of the total turnover in 2001, in 2005 this percentage increased to 10.3% (Bouwkennis; USP Marketing Consultancy, 2007). USP Marketing Consultancy states that this percentage has even risen to 11.4% in 2008 (USP Marketing Consultancy, 2008). Table 7 shows reasons for the costs of failure (USP Marketing Consultancy, 2007). The top 3 reasons mentioned are ‘lack of communication and information transfer’, ‘inadequate attention for feasibility during design phase’ and ‘the delivery of quality to end user as not being the highest priority’. All these reasons underline the current state of a win-lose relationship with clients instead of working together for the benefit of mutual gain to finish projects on time, within budget for a reasonable price. Indirect costs are not taken into account.

Table 7

Reasons for Costs of Failure

	Total	Architect & Engineering	Contractors (General & Sub)	Clients
Lack of communication and information transfer	21%	20%	26%	12%
During design phase inadequate attention for feasibility	20%	19%	22%	19%
Delivering quality to end user is not the highest priority	10%	15%	5%	14%
Requirements list unsatisfactory: lot of changes needed	9%	13%	7%	9%
No application of experience previous projects	6%	4%	7%	7%
Tender model not aimed at integral process procedure	5%	6%	4%	6%
Appointments not followed	5%	3%	6%	6%
Information behind on schedule	4%	4%	6%	2%
No synchronization between architecture & installation	4%	6%	3%	3%
Licenses not on time	4%	3%	2%	7%
Contract unclear and incomplete	2%	0%	2%	2%
Lack of logistic communication during realization	1%	1%	1%	2%
Other, namely	3%	3%	3%	2%
Don’t know	7%	5%	7%	10%
Total	100%	100%	100%	100%

Note. Source: USP Marketing Consultancy 2007

A new approach to public sector procurement such as PIPS should tempt the industry into changing. Not only to rethink more effective ways of procurement approaches which can improve project delivery and business performance, but also to raise industry performance as a whole. The new, innovative forms of procurement must lead to closer co-ordination of design and construction within the whole industry. This will in turn, contribute to substantial savings in terms of time as well as costs (…) (Boes & Dorée, 2008).

Therefore, there is a growing demand for more collaboration between partners in the value chain to lower the failure costs in the industry. In Table 8 results of a Dutch questionnaire are shown for the statement: “further collaboration in the construction industry will lower the cost of failure”. Slightly surprisingly only 47% of all respondents fully agreed on the statement, 30% was ‘neutral’ or ‘did not know’ or had ‘no opinion’. Therefore the ‘disagreement’ percentage was less than a quarter of all respondents.

Table 8

Percentage Agree on Statement "Further collaboration in the construction industry will lower the cost of failure"

	Highly agree	Agree	Neutral	Disagree	Highly disagree	Don't know / no opinion
Architects	2	50	12	29	0	7
Building contractors	5	38	23	26	2	7
Handymans	2	45	18	25	1	9
Building completion companies	1	43	31	13	5	8
Providers of technical services	5	46	17	22	1	9
Total	3	44	22	21	2	8

Note. Source: Bouwkennis, 2006

Use of Performance Information

In the Netherlands innovative procurement and integrated contracts are adopted at different paces. As seen in Table 9, the traditional way of working is still the most used way (total of 71%) in the Dutch construction industry, with only 4% of the total tenders using PPS.

Table 9

Application of Procurement Methods in Various Divisions of Construction

	Traditional	Construction team	Design & Construct	Turn Key	PPS	Total
Utility	73%	18%	5%	2%	2%	100%
Infrastructural work	81%	8%	9%	2%	0%	100%
Specialized	76%	17%	4%	1%	2%	100%
Electro technical	69%	8%	5%	13%	5%	100%
Other installations	61%	19%	5%	3%	11%	100%
Total	71%	16%	5%	3%	4%	100%

Note. Source: EIB 2006

However, PIPS or Best Value Procurement has recently been implemented in The Netherlands at private companies such as construction companies Ballast Nedam (a.o procurement of acoustic fencing along railway track) and Heijmans (a.o: bitumen emulsion). The research of Boes & Dorée (2008) shows that up till now local authorities have been reluctant to move away from tradition, however the national agencies are the frontrunners in this regard. Currently, Rijkswaterstaat (the national government agency whose role is the practical execution of the public works and water management, including the construction and maintenance of waterways and roads) is implementing the methodology. Rijkswaterstaat is a part of the Dutch Ministry of Transport, Public Works and Water Management. Rijkswaterstaat has done a pilot on Best Value Procurement (on a small scale) and will now be using the process to procure circa € 800 mln on infrastructure.

Rijkswaterstaat is using the concept of Most Economically Advantageous Tender (MEAT), as known from European Tender law, more and more. Instead of using points or percentages (fictitious) monetary values are used. The methodology of Most Economically Advantageous Tender gives the client the possibility to not just select based on the lowest price, but to take other criteria into account. In table 10 an analysis is given of the number of projects tendered by Rijkswaterstaat over 2006 en 2007 using either the MEAT process or Lowest Bid (LB; selection based just on the lowest price). In 2007, more than half of the volumic share of tenders by Rijkswaterstaat is based on MEAT, however the number of tenders remains less than a third of the total.

Table 10

Analysis of Projects Using Most Economically Advantages Tender (MEAT) Versus Lowest Bid (LB), 2007 and 2006 of Published Tenders Rijkswaterstaat.

	2007		**2006**	
	Most Economically Advantages Tender (MEAT)	**Lowest Bid (LB)**	**Most Economically Advantages Tender (MEAT)**	**Lowest Bid (LB)**
Project volume (in million €)	787*	660	1243	Unknown
Number of tenders	41	106	37	Ca. 133
Volumic share	54%	46%	Unknown	Unknown
Numeric share	28%	72%	22%	78%
Average project budget (in million €)	19,2	6,2	33,6	Unknown
Average number of suppliers	3,8	3,9	3,6	Unknown
Numeric share ‘LB is not MEAT’	34%	n/a	41%	n/a
Volumic share ‘LB is not MEAT’	21%	n/a	36%	n/a

Note. Source: RWS, 2007 (with permission)
* excluding 2nd Coentunnel

As the table shows, in 34% of the cases in 2007 the awarded contractor did not have the lowest price (thus the award was based on other criteria then price).
Changes towards more innovative procurement methods in the Dutch construction industry are only just beginning. Therefore the industry still suffers from a lack of hard data on the use of Performance Information along the lines of the PIPS methodology. Rijkswaterstaat is not using the Past Performance filter because the Past Performance system for the construction industry is not yet in place. Although Rijkswaterstaat is increasingly using the methodology to procure, unfortunately no data has been collected of the quality of the process and the finished projects. This means that no public data is available on the performance of the projects awarded by the process of “lowest price” vs the projects awarded by the process of MEAT.

Nevertheless, there are ways for construction companies to get insight in their performance through the eyes of their clients. Table 11 shows that the majority of construction firms register 3 types of performance indicators; 1) the number of repeat orders they receive, 2) using 1-on-1 talks with clients after delivery and 3) through employees.

Table 11

Ways of Getting Insight in the Level of Customer Satisfaction

Ways of getting insight	% of companies
Number of repeat orders	70
1-on-1 talks with client after delivery	62
Via employees	51
Complaints registration	25
Regular measurements of customer satisfaction	13
No particular method	4

Note. Source: EIB 2006

By making use of questionnaires, it is possible to show the average customer satisfaction over cooperation with contractors. Figure 5 shows an average customer satisfaction of about 6,7. Only the 'small private firms' and 'private citizens' seem to grade the cooperation with contractors higher. Their satisfaction level over 2005-2007 averaged around a 7,7. All and all, the satisfaction levels of cooperation with contractors are at 'pass' level if it were an examination.

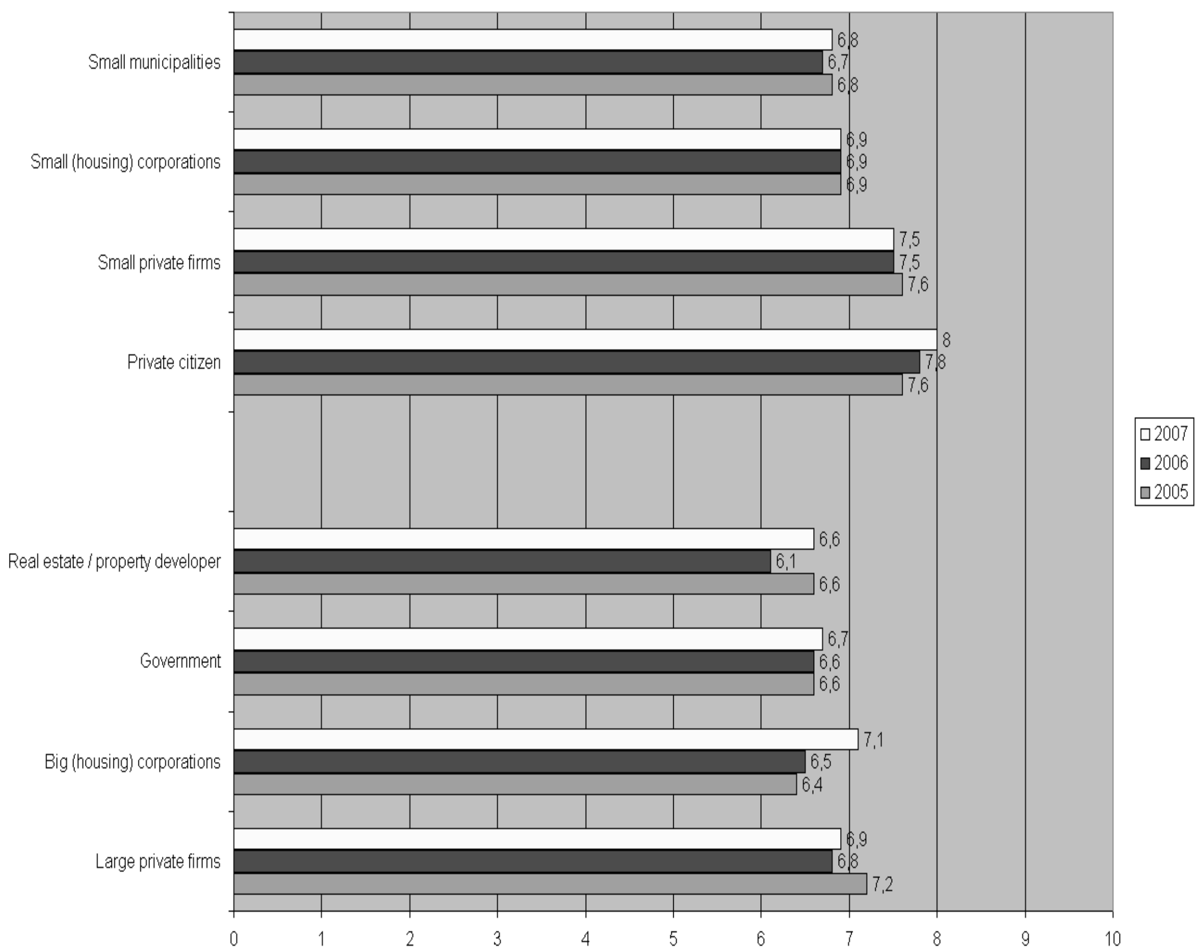

Figure 5: Average grade of customer satisfaction over cooperation with contractors for the years 2005-2007 (scale 1-10) (EIB; 2006)

Selection criteria

The selection criteria that clients use to select a contractor give information on the focus points of the procurement procedure and behaviours of Dutch organisations. Table 12 shows that Large vs. Small clients have different focus points of selection. Where the large clients firstly look at financial data, such as ‘price’ and ‘financial stability’, the small clients focus on ‘reliability’ and ‘quality’ of the contractor. The small client is also focussed on ‘the contractor being customer oriented’. A variable which the small client does not initially considers but is by the large client is the ‘financial stability of the contractor’.

Table 12

Top 5 Most Important Selection Criteria

	Large clients	**Small clients**
1	Price	Reliability of contractor
2	Financial stability	Quality of contractor
3	Reliability of contractor	Price
4	Quality of contractor	Contractor being customer oriented
5	Experience of contractor	Experience of contractor

Note. Source: EIB 2006

The previous outcome seems to be confirmed by looking at Figure 6. The figure shows that Corporations and Government both agree for about 75% that their buying behaviour is mainly aimed at lowest execution costs. Private firms (33%) and Developers (40%) are not predominantly aimed at low execution costs (see Figure 6) but presumably also focus on ‘reliability’ and ‘quality’.

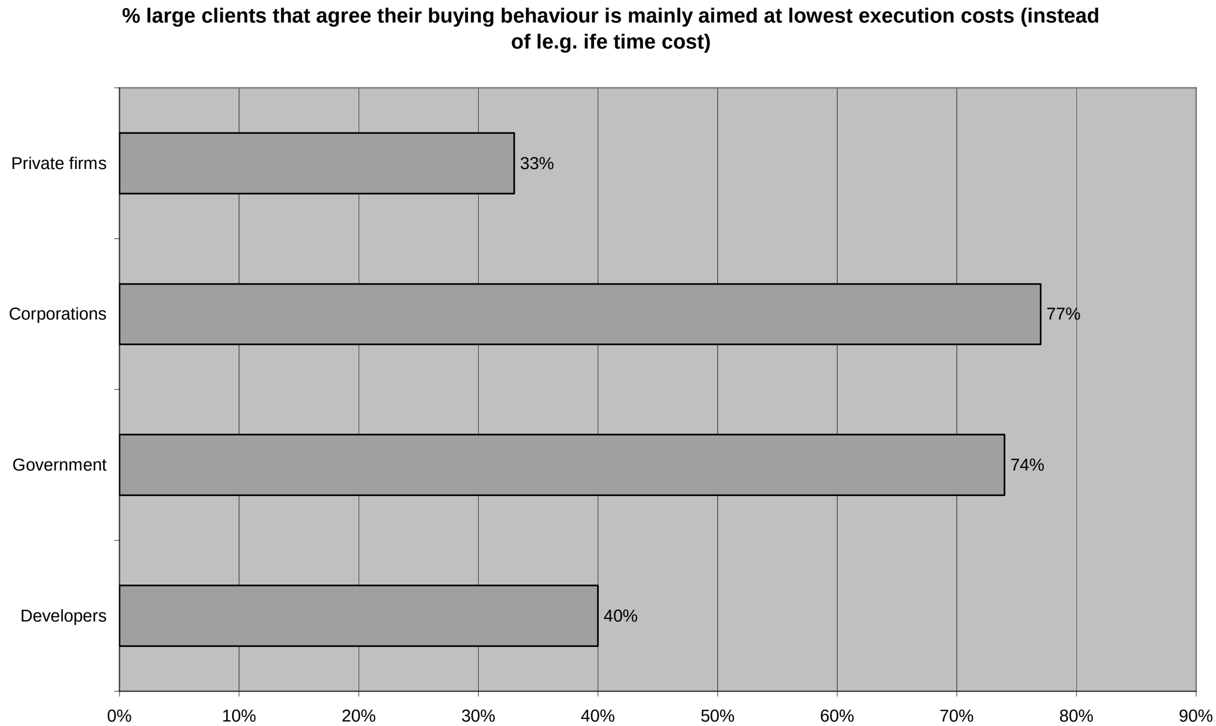

Figure 6: Percentage of large clients that agree their buying behaviour is mainly aimed at lowest execution costs (instead of e.g. life time cost) (EIB (adapted); 2006)

In about 3 out of the 4 instances will Private firms and Corporations archive the performance of contractors (see Figure 7). This data will be used in the future when allocating assignments. Developers only archive this data in 60% of the time and Government, surprisingly as one of the major players in the construction industry, only archives and uses this data for future tenders in 41% of the instances.

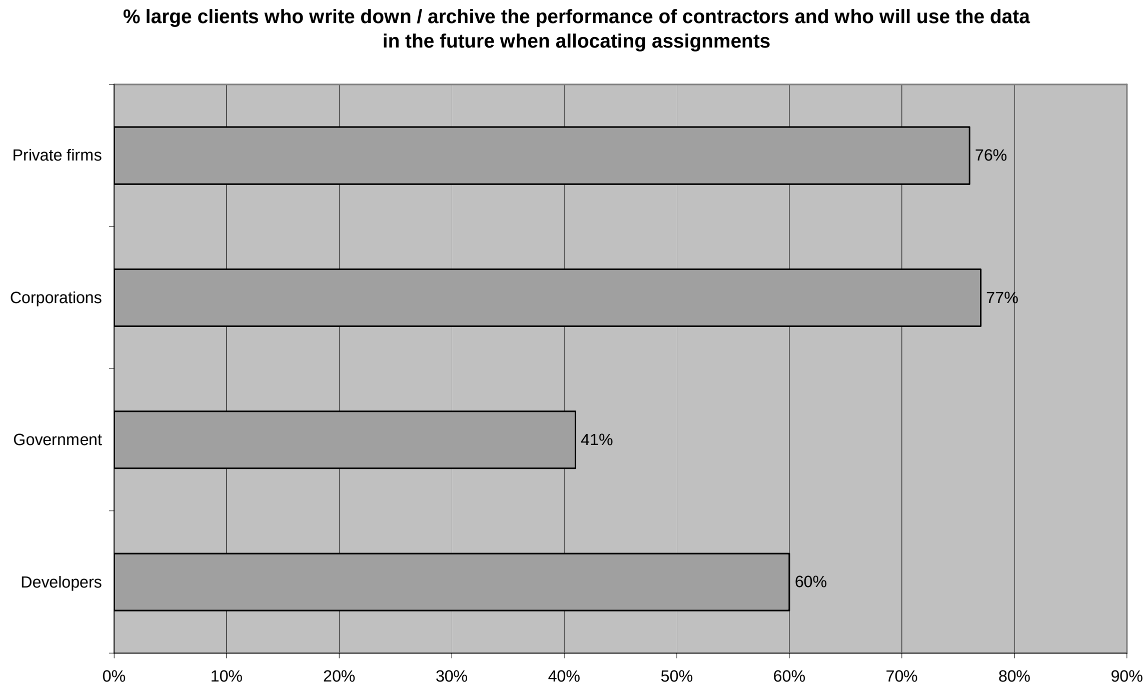

Figure 7: Percentage of large clients who write down / archive the performance of contractors and who will use the data in the future when allocating assignments (EIB; 2006)

Not surprisingly (see Figure 8), it is 50% of Private firms and 40% of the Developers who make use of performance-based contracts. In Figure 5 and consistent with this finding, it were the Private firms and the Developers who were not predominantly focussed on lowest execution costs, but most likely, also quality related criteria. On the contrary, Corporations only use performance-based contracts in 23% of the time. Government only in 16% of the cases.

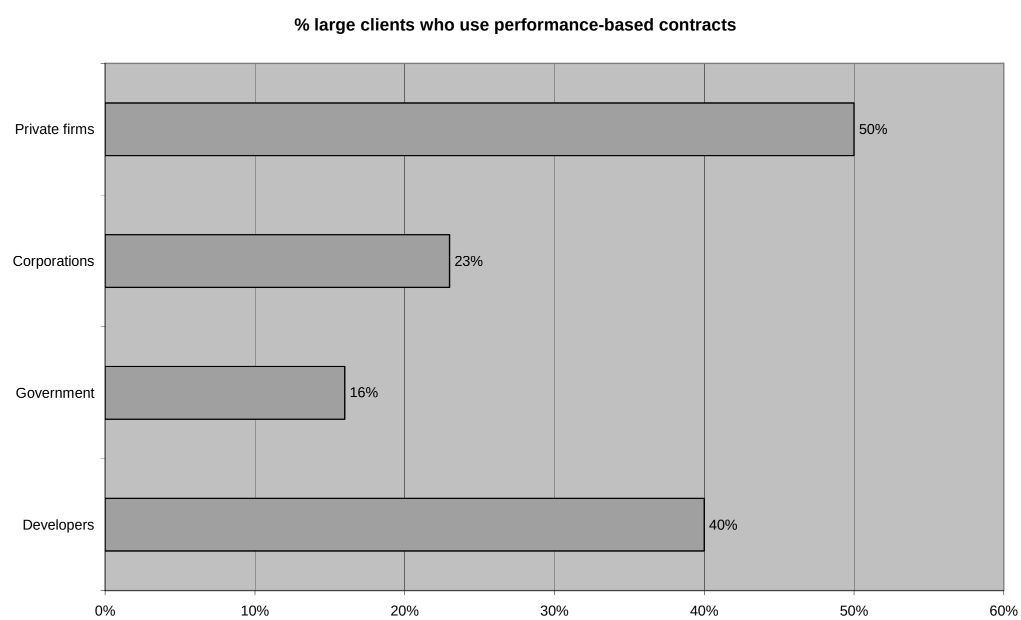

Figure 8: Percentage of large clients who use performance-based contracts (EIB, 2006)

Initiatives of change towards innovative ways of tendering

Competition policies have to strike a balance between competition and cooperation (Dorée, 2004). Competition does not only have to imply lowest price, as quality related criteria are also viable options. Cooperation does not always have to turn in to collusion and corruption, as legal win-win situations can also be attained. As seen throughout this paper, PIPS can contribute to these changes aspired to by the Dutch construction industry as well as bring in added value. However, in the construction sector, this delicate task is further complicated by the fact that government itself is a dominant market player (WRR, 1991 in Dorée, 2004).

The Netherlands, like France and Germany, sees a central role for government as regulator in the market place (Van Waarden, 1996). However, there is little policy drafted especially aimed at transforming the construction industry (Boes & Dorée, 2008). After the parliamentary inquiry into collusion in the construction industry as reported by Dorée (2004), national organizations RegieRaad (Organisation appointed to stimulate change in the construction industry in The Netherlands, 2005) and PsiBouw (Organisation made up of clients, the Construction industry, advisors and researchers to share knowledge and experience around innovation, 2004) were formed to institutionalize and support the change of procurement policy and overall reform in the construction industry. Initiatives were started, e.g. by PIANOo (Public client network for transfer of professional & innovative procurement knowledge) (2004) and Stadswerk (Organisation established for the transfer of knowledge around municipal issues, 1990), to encourage a transfer of knowledge between public clients responsible for tender procedures and purchasing (Boes & Dorée, 2008).

A joint effort of PIANOo, Bouwend Nederland, PSIB and Regieraad Bouw has led to a first pilot of a performance measurement system in the construction industry, with a website called www.pastperformancebouw.nl. In the first half of 2007, test measurements took place. Currently the discussion is on tuning the judicial rules into the system. The taskgroup Past Performance within PIANOo, is currently writing a business plan to further finance the initiative. The current bottleneck is the financing of an independent auditor. The intention is to set up a sector wide benchmark system with independent auditors.

The method currently used is based on a national and international survey of comparable systems and methods prototype designs of the instrument, the related discussion in several workshops, involving experts from both public clients on national and municipal levels and contractors, and the discussion of the interim results in a broad platform of actors involved, such as PIANOo, Bouwend Nederland, Regieraad and PSIB (Geraedts & Wamelink, 2007). Bilateral discussions with external experts and several trial measurements were performed on location-specific practical projects to test and evaluate the instrument's workability and expressiveness.

In order to make the performance measurement system work, there needs to be:

- Objective measurements and data

- Performance criteria being verifiable
- Contractual documents
- Dialogue; a willingness to listen to each others’ standpoints
- Tribunal; a way to solve differences
- A solution for newcomers in the industry

The effort is aimed at getting some kind of an industry standard.

In the mean time there are also initiatives at company level. KWS Infra (a subsidiary of Volker Wessels) is studying the merits of Best Value Procurement. Heijmans NV is also implementing the PIPS methodology. Scenter introduced the methodology at IHC Merwede, the world’s market leader in the design, fabrication and supply of equipment and services for the dredging and alluvial mining industries. Scenter also executed a market-consultation before the start of the formal tender procedures for Rijkswaterstaat to see how the Dutch construction market would react to the rather new way (in the Netherlands) of tendering based on Best Value Procurement.

The main reason for Rijkswaterstaat for using the Best Value process is that the procurement of ‘Design and Build’-contracts usually leads to high transaction costs (efforts of all possible suppliers). At this time the tender capacity in the market is limited. Therefore suppliers have asked Rijkswaterstaat to develop a procurement strategy based on quality aspect to lower the transaction costs. Rijkswaterstaat has adopted Best Value Procurement to address this issue and tender major infrastructural works valued at €800 million. The outcome of the market-consultation showed that almost all suppliers are happy to see that quality (and not price) will be the major criterion in the process of awarding a supplier.

Also seven of the largest construction firms in the Netherlands have set up a kind of code of conduct. BAM, Volker Wessels, Heijmans, TBI, Ballast Nedam, Dura Vermeer en Strukton are well willing to cooperate more and better with their subcontractors and suppliers. A press release in Cobouw on the 30th of januari 2008 confirmed this. Experience of former projects with optimal cooperation show that the cost of failure can be reduced to the minimum and major cost reduction can be achieved. This way the construction industry will be more professional, social responsible and transparent and subcontractors will be chosen not only by price but *also* on quality. Suppliers and specialized contractors will be stimulated to develop themselves into co-makers or preferred suppliers (Cobouw: January 30, 2008).

Conclusion and Discussion

In reaction to the construction collusion of 2002, the Parliamentary Committee proposed tougher public sector procurement procedures and put its trust in the cleansing capacity of competition. This resulted in a natural defensive approach within the construction industry – focusing on control and preventing potential problems on accountability, legitimacy and reputation (Boes & Dorée, 2008). Collusions and cartels are viewed by most authorities as the single most serious violation of competition laws (OECD glossary, 1999). However the boundaries brought about by legislation need consideration. Duren & Dorée (2008) argue that European tender rules and laws do not allow the integrated application of PIPS (…). According to them there is a certain friction between the tender principles (non-discrimination, transparency and objectivity) (…) (Duren & Dorée, 2008) and the application of PIPS in its original form. But, whether the EU legislation is biased toward traditional contracting, or whether it is just perceived that way, should be debated.

Although officials as well as managers are aware of the “pressures” towards more innovative procurement routes, the old practices are persistent. General managers in the construction industry seem as much engineers now as they were a decade ago. An explorative quantitative study shows that the mainstream paradigm of construction industry leaders today is much as it was in the past: technology- and project-oriented. (Pries, Dorée, van der Veen and Vrijhoef, 2004)

MacMillon (2001) points to the central role that governments have in supporting innovation via the regulatory framework. This study shows an analysis of 55 years of publications in two leading Dutch professional journals (Pries and Dorée). Innovations in construction remains to be technology- rather than market-driven. But regulations have a surprising impact, as over one-third of all counted new innovations are related to new regulations (Pries and Dorée, 2005). This finding can thus also be applied to regulations on procurement and tendering procedures with a obligatory broader focus on quality criteria in addition to lowest price. In addition, government itself, as mentioned before, is the major client in the Dutch construction industry and therefore can set the pace of change. Rijkswaterstaat is a good example of a national agency taking its front-runner position for change towards more innovative procurement procedures.

Adopting new and more innovative ways of procurement via tendering procedures such as PIPS does give rise to tension within the industry. The larger contractors – specifically those working for state agencies – are quick to acknowledge the changes in the market and to act (Boes & Dorée, 2008). But the SME’s (Small and Medium Enterprises) are at risk of being pushed out of a market traditionally theirs. In the Netherlands this already resulted in the birth of a new contractors association for SME’s in construction, taking a position against the larger contractors and policies that favor larger contractors (Boes & Dorée, 2008).

There is an explicit need for Performance Information on the industry as a whole, yet little ‘hard’ data is available. Resistance to change to potentially better ways of procurement are being strengthened by the fact that such ‘hard’ data does not exist. A few initiatives are being started of which one initiative is sector-wide while another initiative is at company-level, however more initiatives are needed to provide an objective and significant scope on this topic within the Dutch construction industry.

A movement to new integrated contracts and quality based selection is visible in certain regions but is still in its infancy (Boes & Dorée, 2008) in the Dutch construction industry. As in other industries, firms in the construction industry need to become more client- and market-oriented and innovative ways of procurement procedures, such as PIPS, are seen as a crucial factor in these change processes. The added value consists of better project results (more projects within planning, budget and clients’ expectations, more value for money) and cooperation (Duren & Dorée, 2008).

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A Case Study of a Best Value Manufacturer

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This is a case study of a construction product manufacturer's effort to become a profitable manufacturer of roofing systems while providing a best value product to the client (best performance at the lowest cost.) The manufacturer was attempting to become successful with product performance in an industry where low performance of competing products brought a perceived high risk of nonperformance from clients. The manufacturer's efforts included documentation of performance of their installed product, creating a risk management process, testing the risk management process and creating a supply chain structure which minimized the risk of both the manufacturer and the client. The key component of a best value manufacturer is the identification of the true buyer of their materials is the owner of the facility which buys their product and not the contractors. This paper documents the transformation from not having performance information to having documented performance on their product, developing a risk management program, and exercising their risk management program. This includes the formulation of a performance based contractor program and the application of the Performance Information Risk Management System (PIRMS.)

Keywords: Coatings, Roofing, Waterproofing, Best Value, High Performance, Neogard

Introduction

In the 1990's Neogard (a manufacturer of high performance industrial coatings) was faced with a problem in the sprayed polyurethane foam (SPF) roofing industry. They were embedded into an industry where manufacturers/contractors sold products to clients based on warranties that did not protect or minimize the risk of the client. SPF roof system performance was very unpredictable. Clients were buying SPF roofing based on the long term stated duration of the warranty, which had no documented correlation with actual performance periods. The warranties were embedded with disclaimers or exclusions that made many of the warranties difficult to enforce. The practice of some manufacturers cast a pall over the entire industry and has stunted the growth of the SPF roofing industry to less than 5% of the roofing marketplace for the last twenty years.

Deductive logic and common sense identify that a warranty protects the manufacturer and not the client:

1. The warranty is a contractual document between the manufacturer of the product and the client.
2. The warranty is written by a lawyer who represents the manufacturer.
3. The warranty has no proven correlation with actual performance periods.
4. The warranty has to be enforced.

5. The client has to prove that the roofing system they purchased does not meet the stated purpose, and that the manufacturer is responsible for the problem.
6. The client has to prove that they did not cause the problem.
7. The client must then get the roofing manufacturer to acknowledge the problem, acknowledge that they will fix the problem, and actually fix the problem.

In the sprayed urethane foam industry, which is one of the industries Neogard provides their products, an owner may have difficulty in getting a manufacturer to react to problems covered by the warranty and to fix the source of the problems. Manufacturers in the SPF industry do not keep performance records on their product or their applicators. The SPF roof system is one of the most complicated to install because it is installed on site, using a two component SPF which is highly reactive to not being mixed in proper proportions, at the right temperature (which requires very high and accurate heating), with proper equipment and installation, and in an environment that must be free of moisture. There are cases where the SPF or coating manufacturers have not responded to client concerns, have had their products installed in a suboptimal manner by contractors who were either not capable of installing the SPF roof systems properly or who were not paying proper attention to the constraints of the project environment, and who did not provide adequate supervision on the projects.

The authors have personal knowledge of a very large SPF roof manufacturer warranty representative who gave the following responses to a client over a period of five years on a SPF roof installation:

1. We have never had that problem before.
2. It is due to contractor error.
3. It was fixed (when it was not fixed.)
4. We have the contractor scheduled to come out and take a look at it (and no one responded to the site.)
5. The contractor has done the repairs (and the repairs are not done properly and led to more problems.)
6. We have paid the contractor to make the repairs (and no one made the repairs.)
7. The manufacturer’s warranty representative came out and took a look at the roof (and no one visited the site.)
8. The manufacturer determined it is contractor error, and the manufacturer is not liable (even if the contractor was identified is a qualified applicator.)

SPF and coating manufacturers use distribution systems to distance themselves from the contractors and minimize their liability. By doing this, they do not have liability for nonperformance caused by improper installation. Owners, who do not understand the impact of product distribution systems, do not know the difference between a systems warranty that covers nonperformance due to materials and installation and a materials only warranty. When there is a materials only warranty, it is very difficult to prove that the problem was not caused by improper application.

A properly installed coated SPF roof system installed in a retrofit environment is a very green, sustainable, cost effective, and extremely value oriented roof system. This is only if it is installed by a highly qualified contractor, using very high performance coating and SPF materials. However, if all these factors are not present, a roof owner can find himself with a roofing fiasco, which explains why, over the last 20 years despite some very high performance, the percentage of SPF roof systems has not increased over 5% of the roofing market. The most important step a potential roof owner can make when purchasing a high performance SPF roof system is to identify if the manufacturers and contractors have documented proven performance and a quality control/risk management system that will protect the roof owner.

Neogard found itself in a very uncomfortable position as a manufacturer of high performance installed products, in an industry which was filled with false promises and low priced and low performing competitive systems. Neogard is a manufacturer of an aromatic urethane coating for sprayed in place polyurethane foam (SPF) roof systems. There were facing the following challenges:

1. The false perception that all urethane coatings including their high performance product called "Permathane" had a problem with reversion (the transformation from a solid back to its initial two component liquid state).
2. Marketing and sales people of other manufacturers who were selling aliphatic coatings. Aliphatic coatings were a high solids, higher bonding urethane material that exhibited a higher initial gloss than Neogard's aromatic "Permathane" coating. However, the aliphatic coatings did not have the proven documented performance of the Permathane coating. The aliphatic coatings started to fail (reversion and cracking due to brittleness) while the aromatic Permathane coating became the highest performing coating.
3. Other roofing material manufacturers outside of the SPF industry were identifying the SPF systems as inexpensive and temporary roofing system which could not handle foot traffic (which was true of many of the other acrylic and silicone coated SPF systems, but not the properly installed Permathane coated SPF roof system.)
4. An entry of an "inexpensive" aggregate covered SPF roof system that was being sold for half the price of a urethane coated SPF roof system but oftentimes due to its extremely low cost, lacked the quality of installation of the higher performing SPF systems.
5. Contractors were installing systems material which were not always the highest performing, but rather the quickest and easiest to install. This included systems which used a quicker to install one or two coat elastomeric acrylic or silicone system instead of a three or four coat urethane elastomeric coating system.
6. Manufacturers were selling the SPF system materials through distribution where contractor performance was not a requirement to purchase the material, leading to many failures of SPF systems (References.)

Problem

The problem is one faced by many manufacturers of products in the construction industry. How does a manufacturer of high performance products differentiate their product from the manufacturers who are producing commodity products which may have inconsistent performance, high risk, and lower pricing? How would a high performance manufacturer protect itself against low performing contractors who do not act in the best interest of the manufacturer or the client? How would the manufacturer protect itself against other manufacturers' lower cost products that may be used in place of their longer lasting, more costly higher performing systems? How does a manufacturer of high performing systems sustain itself in a low priced marketplace where the clients/buyers cannot tell the difference between products?

In 1996 Thom Tisthammer, one of the foremost experts in the installation of sprayed polyurethane foam (SPF) roofing, and an applicator of Neogard's "Permathane" coated sprayed polyurethane foam (SPF) roof system, introduced Mike Steele, President of Neogard, to Dr. Dean Kashiwagi, Director of the Performance Based Studies Research Group (PBSRG) at Arizona State University (ASU.) He encouraged Neogard to adopt some of the performance based concepts being proposed by PBSRG.

The PBSRG was one of the few research groups in the United States experimenting with best value performance based procurement systems (including the Performance Information Procurement System (PIPS)) and which later developed the Performance Information Risk Management System (PIRMS). These performance based systems maximize the value of construction systems and protect the client against the risk of non-performance. PBSRG proposed that the problem of nonperforming construction was a systems problem (Deming, 1982) caused by the client's price based procurement system. PBSRG was encouraging owners to use past performance measurements on both the manufacturer and contractors performance to minimize the risk of nonperformance in the delivery of roofing systems.

At this time, Neogard was contemplating leaving the roofing marketplace due to the litigation and risk of nonperformance of their installed roof systems. The risk was very high, costs were increasing and the profit margins were decreasing. Neogard requested PBSRG investigate whether it was possible to change the competitive climate by doing the following:

1. Identify a method to differentiate Neogard's high performance products and roof systems from other manufacturers based on product performance.
2. Create a structure to identify high performance contractors who could install Neogard products, minimizing the risk of nonperformance caused by improper installation.
3. Create a process that would motivate contractors to minimize risk through preplanning, adequate pricing, and using best practices and qualified personnel.
4. Institute a transparent, information based environment that would motivate contractors to fix the problems caused by application error instead of forcing the manufacturer to pay for the problem,
5. Identify a method to identify high performance clients who could understand the value of Neogard's products.
6. Identify a strategic plan to maximize the sales of Neogard's products.

Hypothesis

The hypothesis of this research was that a manufacturer of high performance products could be successful in the construction industry that was heavily based in a price based environment.

Successful would be determined by the ability to differentiate itself by performance, to minimize risk of nonperformance, to be sustainable, and to have satisfied clients of their installed systems.

Methodology

This research project will use the deductive logic approach. It will use common sense concepts that are well recognized in general business and apply the concepts to confirming the hypothesis. The following steps will be used:

1. Identify if Neogard had a high performance product and that their product could be differentiated based on a dominant environmental requirement.
2. Use the Construction Industry Structure (CIS) model to identify which environments would result in their company being sustainable and what practices should be implemented.
3. Create and test a risk minimizing contractor program which would dominantly identify the performance of the manufacturer's product.
4. Create a risk management system that would minimize the risk of nonperformance of their installed systems.
5. Align the high performance supply with clients who would understand the value of their installed systems.
6. Identify how Neogard could implement the risk minimization contractor program, risk management program, and alignment with high performance clients.

Identification of a High Performance Product

PBSRG asked Neogard to identify why they perceived their urethane coated (Permathane) coating as the highest performing coating system for SPF. Neogard listed the following attributes:

1. Performance in heavy hail areas.
2. Longevity in the performance of its coating systems.
3. Joint and several warranty.

PBSRG conducted two research projects in 1996 and 1999 to identify the performance of the Permathane system in heavy hail areas:

1. Initial hail test of Neogard's coatings (urethane, silicone, and acrylic coatings) in accordance with Factory Mutal –Sever Hail Test # 4470 (FM-SH test.) The research tests were expanded to include in-field tests of installed systems.
2. Follow-on oversized hail testing using the FM-SH test specification for larger sized hail and also for cold weather testing near freezing temperatures.

The Factory Mutual Severe Hail Test (FM-SH) #4470 has the following major components:

1. Testing samples of new material (material samples which have not been weathered in actual environmental conditions) dropping a 1-3/4 inch steel ball from 17-3/4 feet on the newly coated sample which is prepared according to the specifications of the installed system.
2. Aging the sample in a weatherometer (which has no correlation with actual weathering), and retesting the samples.
3. The FM-SH test did not include field testing of aged systems (the only accurate method of predicting product performance in actual environmental conditions.) The correlation between the weatherometer's impact on the material systems and actual aged systems in the field has not been confirmed.

The 1996 tests results included (Kashiwagi, 1996):

1. The only test sample that passed the FM-SH test requirements at coating thicknesses that were currently being specified was the moisture cured urethane Permathane coating.
2. Field tests of installed silicone, acrylic, and urethane coatings resulted in identifying the moisture cured Permathane coating as the only coating that passed the FM-SH test requirement of not breaching the coating when hit by a 1-3/4 inch steel ball dropped from 17-3/4 ft elevation.
3. These results conflicted with the FM test results which passed all three coating systems. Follow discussion with FM to retest the samples based on the ASU testing results was unsuccessful.

The 1999 "Oversized Hail" test results" included (Kashiwagi, 1999):

1. Permathane coating installed at 45 mils average, and 35 mils minimum thicknesses could withstand a much larger size hailstone (up to four inches in diameter) without fracturing/breaking through the coating.
2. The coating could potentially perform at freezing temperatures.

Follow up hail testing using the FM-SH requirements in field conditions conducted in 2008 and 2009 (Tables 1 and 2) on the moisture cured urethane Permathane coating has yielded the following results:

1. Requirements successfully passed on a 22 year old roof installed at the Casa View Elementary School in 1987. The roof coating had an average thickness of 49 mils, and a maximum thickness of 50 mils.
2. Requirement successfully passed on four roofs in Torrington and Cheyenne, Wyoming with an average age of 16 years (maximum 19, minimum 13 years) with an average coating thickness of 32 mils and an average minimum of 16 mils. Each roof tested had a previously expected life of 10 years (based on the warranty period.)
3. Requirement was also partially met in the Fall of 2008 while running the FM-SH tests in deck temperatures of 49 degrees Fahrenheit. The system may not be able to pass if the coating thickness is less than 45 mil average / 35 mil minimum. Tests that failed at 53 degrees F had an average coating thickness of 28 mils (standard deviation of 9 mils) and a minimum thickness of 12 mils (standard deviation of 5 mils.) Tests that succeeded had

an average coating thickness of 35 mils (standard deviation of 11 mils) and minimum thickness of 21 mils (standard deviation of 10 mils.)

Table 1

Overall Resistance to Hail

No	Criteria	Unit	Fall	Summer	Failed	Passed
1	Average Surface Temperature (F)	Degrees F	53	152	49	103
2	Average Coating Thickness	Mils	32	35	28	35
3	Average Coating Thickness – Std. Deviation	Mils	11	9	9	11
4	Minimum Coating Thickness	Mils	18	21	12	21
5	Minimum Coating Thickness – Std. Deviation	Mils	10	8	5	10
6	Maximum Coating Thickness	Mils	40	46	35	43
7	Maximum Coating Thickness – Std. Deviation	Mils	9	8	8	8
8	Number of Drops	#	58	40	17	81

Note. Fall tests were conducted in November 2008. Summer tests were conducted in August 2009.

Table 2

Roof System Performance

No	Job	Size	Year Installed	Age When Tested	Customer Satisfaction	Ever Leaked?	Currently Leak?
1	EWC: Kitchen	17,000	1993	16	10.0	No	No
2	EWC: Tebbets Backwings	21,000	1990	19	10.0	No	No
3	EWC: Fine Arts Classroom	13,000	1994	15	10.0	Yes	No
4	State of WY: Surplus Bldg	17,500	1996	13	10.0	No	No
5	Dallas ISD: Casa View ES	61,100	1987	22	9.0	Yes	No

Note. Roofs 1, 2, and 3 are in Torrington, WY, roof 4 is in Cheyenne, WY, and roof 5 is in Dallas, TX.

The test results on the majority of the roof systems were done on 40 psi SPF with 35 mils average thickness of Permathane (minimum thickness of 21 mils.) The high performance Alpha system that is warranted against FM-SH size hail damage is specified at 45 mils average thickness (35 mils minimum) with a 15 year service period. These hail test results differentiate the Neogard Permathane coated SPF roof system in the following ways:

1. It is the only coated SPF roof system that has proven documented hail resistance of over 15 years.
2. It is the only coated SPF roof system that has documented performance in hail areas without recoating for 20 years.
3. It shows documented performance with minimal degradation for 20 years.

The hail resistance and performance of the aged Permathane systems shows both durability and resistance against loading such as foot traffic for an extended period of time that is unusual for SPF roof systems. The system is lightweight, monolithic, has the highest insulating capability, and its renewable structure give it physical and economical advantages over conventional built up roofing and modified bitumen systems in retrofit situations when the existing roofing system does not have to be removed. The biggest constraint to installing a high performance SPF roof system is having a high performance contractor who can consistently install high performing materials properly.

Construction Industry Structure (CIS) Business Approach

The CIS approach (Figure 1) is a simplistic and yet sophisticated strategy. The approach has different objectives for each of the three stable environments, which are the priced based environment, the best value environment, and the negotiated bid environment. The best value environment is where high performance contractors compete based on value (performance and price.) This is an environment where the contractors and manufacturers document the performance for the product in terms of the following factors:

1. Customer satisfaction.
2. Percent of roofs leaking.
3. Percent of roofs that do not leak.
4. Percent of roofs that never leaked for any reason.
5. Percent of roofs with more than one percent deterioration.
6. Maximum, average, maximum age of the roof system.
7. Age-sum of the roofs that never leaked (adding up the number of years of all roofs that have never leaked.)
8. Average number of traffic on the roofs.
9. Average area of the roofs.
10. Percent of roofs with more than .25/12 slope.
11. Number of penetrations per area of the roof (roof failure is increased by penetrations due to flashing details.

The best value environment is where there is an alignment of the manufacturer's high performance product, the high performance skills of the contractor, the use of performance information in the selection of the contractor which ensures that the client is a best value client, and the use of logical, common sense risk management practices. In the best value environment, the best value client transfers the risk, control, and accountability to the best value vendor. The risk of nonperformance and high costs is almost non-existent if the following is accomplished:

1. Contractors are measured in terms of performance.
2. Client transfers the risk of nonperformance to the contractor and manufacturer, and forces contractors to identify, manage, and minimize risk that they usually do not control.
3. Contractor and manufacturer identify to the client the technical scope of the project as a part of their preplanning.
4. Contractors use a risk management plan to manage and minimize the risk they do not control.
5. Contractors use a weekly risk report to document deviations to their installation plan.
6. Contractors minimize the risk of nonperformance during and after the installation for the duration of the warranty period.

The only way to economically minimize the risk of the warranty period is to have minimal risk. Minimal risk is the result when the vendor is an expert in the installation (they know what they are doing) and using high performance products. Warranties have less meaning in the best value environment, due to the minimized risk of high performance contractors installing a high performance product. The purpose of warranties is to minimize the risk of lower performing manufacturers and contractors in a price based environment.

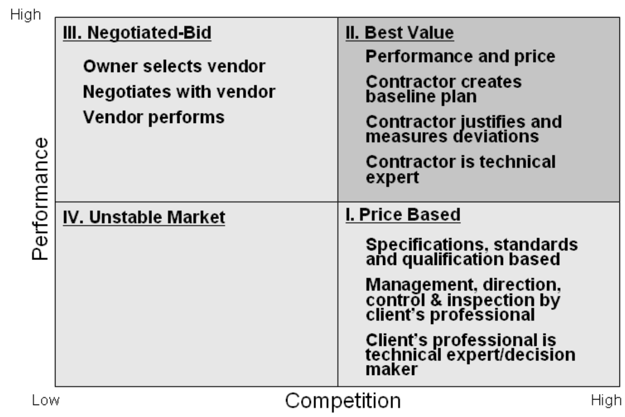

Figure 1: Construction Industry Structure

In the price based arena, clients perceive that all installed products have the same performance and the best value is the lowest possible price. Characteristics of the priced based environment include:

1. The client and the client's representative are the expert. They direct the vendor on what to do, how to do it, manage and control the vendor's installation, and only buy the lowest priced alternative.
2. The manufacturer and contractor have very low risk. They use the warranty to further minimize their risk.
3. Manufacturers use the system of distribution in the price based environment, further separating themselves from any liability of the installation of their products. Warranties are usually material only, and if labor and materials are also covered, the manufacturer will force the client to prove the source of the nonperformance which is costly and difficult to do.
4. Manufacturers and contractors sell in large quantities at lower profit margins.
5. There is no monitoring and risk and performance of products, systems, or contractors.

There are two other subtle assumptions in the price based arena. First, the client assumes someone can perfectly identify what is required and what will happen and perfectly communicate that to a second entity or individual. Secondly, the second entity or individual perfectly understands the perception/expectation of the first individual/entity. The third assumption is that this concept can be transferred to and understood by not only one entity but three or four individuals/entities. And because they are all equal, the low price is the best value. However, when the low price entity is selected, many times it is perceived by the buyer/client that the low price vendor does not understand the requirement how to install the system to meet the expected performance.

The owner's representative then assumes falsely that they can manage, direct, and control the vendor during the installation and after the installation during the entire service period identified by the contract/warranty. This has proven to be ineffective, inefficient, and leads to transaction laden outcomes. Many clients do not understand that the manufacturers of the products have a difficult time controlling the performance of their own contractors. The low price environment structure is responsible for the resulting low level of performance and high risk of the roofing market. This is especially true for the SPF roof system.

In the negotiated bid arena, the quality should be of the same level as the best value environment; however, in many cases the following is not present due to the lack of competition:

1. Performance measurements.
2. Documented risk management system.
3. Tracking of performance after installation.
4. Effectiveness and efficiency of the best value environment.

Using the CIS business approach, the construction industry and clients of the construction industry operate in all three environments. To maximize profit and sustainability, the CIS approach dictates that Neogard do the following:

1. Release all control to the clients in deciding what environment they are requesting the product installation. They must therefore offer their products/installed system in all three environments.
2. To maximize their profit, they must have a foundation of performance that is ensured by a quality control/risk management system, performance measurements, and a performance based contractor program in the best value environment.
3. They must market their products in the price based and negotiated environments using the potential performance of high performance installations.

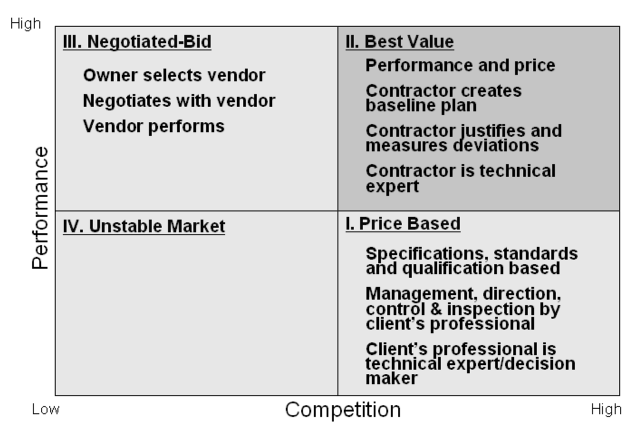

Figure 2: CIS Solution

High Performance Roofing Program

Over the last ten years, a performance based roofing program was developed for Neogard called the Alpha program. It is the only performance based contractor program run by a manufacturer in the roofing industry. The requirements of the Alpha roofing program was initially set by the high performance contractors participating in the program and were modified over time to increase the effectiveness and efficiency of the program. The requirements of the program include:

1. Have a "good financial standing" with the manufacturer (Neogard.)
2. Inspect and survey 25-50 elastomeric-coated SPF roof systems and have a random telephone survey on all other roofs in their database.
3. Roof inspections once every two years of a maximum of 50 roofs, and a minimum of 25 roofs.
4. Annual submission of newly installed SPF roofs over 5,000 SF to Arizona State University
5. 98% of roofs being tracked cannot currently leak.
6. 98% of surveyed roofs must have satisfied customers.
7. The contractors must attend the annual educational presentation given by Arizona State University on the risk management systems.
8. Tracking of performance of all other vendors of material in the Neogard system.

The program is performance based because entry into and exit from the program is based on performance measurements. All contractors must document their performance with periodical inspections and the third party verification. Random calls by a third party are made to verify the performance of a contractor. Contractors are eliminated from the program if they do not maintain the 98% customer satisfaction of their documented roofs (with a minimum 70% client response rate required.) Contractors could also be eliminated from the program if they did not meet the financial requirements of Neogard, or if the manufacturer decided that the contractor was not acting in the best interest of the Alpha program or Neogard.

The best value clients are procuring the product based on proven, documented performance and the assurance that the contractor/manufacturer has a risk management system in place to minimize risk. The manufacturer runs the risk management system to minimize its risk of liability and litigation that is caused by improper application. The high performance Alpha system has the following advantages:

1. Performance measurements force accountability of contractors to install the product/roof system correctly.
2. Risk management systems force contractors to manage and minimize the risk that they do not control, risk that they usually are not responsible for.
3. Risk management forces contractors to identify their assumptions, constraints and potential risks, and forces them to preplan to manage and minimize the risks, and to identify any deviations to their preplanned scope.

4. The performance measurements assist the contractor and their personnel to continuously improve.
5. An environment of preplanning, risk management, and performance measurements increases the technical and professional skill of the contractors and their personnel and will attract the best of vendors and their personnel.

Since the Alpha Program's inception, 11 contractors have dropped out. The major reasons for discontinuing involvement are summarized below.

Table 3

Contractor Reasons for Discontinuing Involvement

No	Criteria	Rating
1	Did not keep up with performance data list and inspections	64%
2	Terminated from program	19%
4	Switched business market	10%
5	Competed with Neogard	10%

Table 4 shows the performance ratings of the contractors involved in the program. Table 5 shows the progression of the performance since the inception of the program. Tables 6 and 7 highlight a couple contractors who have been in the program multiple years, and show their performance over the last three years. Manufacturers and contractors can use the performance information for continuous improvement, relative comparison of performance and value, and to prove to clients that their roofing system performance is not based simply on a manufacturer's warranty. The collection of performance information is the only one of its kind in the SPF roofing industry, the roofing industry, or the waterproofing industry. For more information, browse to www.pbsrg.com.

Table 4

Current Alpha Contractor Performance Lines (Contractors A – D)

No	Job	Unit	A	B	C	D
1	Overall Contractor Performance	(1-10)	9.1	10.0	9.7	10.0
2	Oldest job surveyed	Years	23	3	19	23
3	Average age of jobs surveyed	Years	10	1	12	8
4	Age sum of all projects that never leaked	Years	150	14	119	77
5	Age sum of all projects that do not leak	Years	358	19	144	145
6	Percent of customers that would purchase again	%	100%	100%	100%	100%
7	Percent of jobs that do not leak	%	92%	100%	100%	100%
8	Percent of jobs completed on time	%	100%	100%	100%	100%
9	Percent of satisfied customers	%	97%	100%	100%	100%
10	Percent of insp. roofs with less than 5% ponded water	%	100%	100%	100%	100%
11	Percent of inspected roofs with less than 1% deterioration	%	96%	100%	96%	100%
12	Percent of inspected roofs with less than 1/4" slope	%	89%	93%	89%	100%
13	Average job area (of jobs surveyed and inspected)	SQ	497	569	122	234
14	Total job area (of job surveyed and inspected)	SQ	24,334	8,529	3,300	5,845
15	Total number of returned surveys / Num. of jobs surveyed	#	39 / 54	14 / 15	12 / 27	18 / 26
16	Total number of jobs inspected	#	54	15	27	26
17	Total num. of different customers surveyed & inspected	#	32	5	15	11
18	Total number of Alpha Inspection Surveys	#	4	1	5	3
19	Certification Status	Status	US	C	C	C

Note: Under “Certification Status”, US stands for “Under Survey” and C stands for “Current”

Table 4, cont’d

Current Alpha Contractor Performance Lines (Contractors E – I)

No	Job	Unit	E	F	G	H	I
1	Overall Contractor Performance	(1-10)	9.8	9.8	9.8	9.8	9.8
2	Oldest job surveyed	Years	27	5	13	33	17
3	Average age of jobs surveyed	Years	18	4	5	19	10
4	Age sum of all projects that never leaked	Years	785	173	70	388	194
5	Age sum of all projects that do not leak	Years	863	201	116	800	287
6	Percent of customers that would purchase again	%	100%	100%	100%	100%	100%
7	Percent of jobs that do not leak	%	100%	100%	100%	100%	100%
8	Percent of jobs completed on time	%	100%	100%	100%	100%	100%
9	Percent of satisfied customers	%	100%	100%	100%	100%	100%
10	Percent of insp. roofs with less than 5% ponded water	%	100%	100%	56%	100%	100%
11	Percent of inspected roofs with less than 1% deterioration	%	98%	98%	63%	92%	98%
12	Percent of inspected roofs with less than 1/4" slope	%	88%	93%	60%	94%	100%
13	Average job area (of jobs surveyed and inspected)	SQ	195	419	196	778	248
14	Total job area (of job surveyed and inspected)	SQ	9,940	22,207	8,213	38,899	14,907
15	Total number of returned surveys / Num. of jobs surveyed	#	49 / 51	53 / 53	22 / 42	44 / 51	30 / 60
16	Total number of jobs inspected	#	51	53	16	51	60
17	Total num. of different customers surveyed & inspected	#	6	2	27	19	48
18	Total number of Alpha Inspection Surveys	#	9	4	2	5	5
19	Certification Status	Status	C	C	C	C	US

Note: Under “Certification Status”, US stands for “Under Survey” and C stands for “Current”

Table 4, cont'd

Current Alpha Contractor Performance Lines (Contractors J – N)

No	Job	Unit	J	K	L	M	N
1	Overall Contractor Performance	(1-10)	9.8	9.7	10.0	8.7	9.7
2	Oldest job surveyed	Years	23	11	7	26	6
3	Average age of jobs surveyed	Years	12	7	3	9	3
4	Age sum of all projects that never leaked	Years	303	206	77	213	99
5	Age sum of all projects that do not leak	Years	425	274	77	438	116
6	Percent of customers that would purchase again	%	100%	100%	100%	100%	100%
7	Percent of jobs that do not leak	%	100%	100%	100%	100%	100%
8	Percent of jobs completed on time	%	100%	100%	100%	100%	100%
9	Percent of satisfied customers	%	100%	100%	100%	100%	100%
10	Percent of insp. roofs with less than 5% ponded water	%	100%	100%	100%	98%	100%
11	Percent of inspected roofs with less than 1% deterioration	%	100%	100%	100%	90%	91%
12	Percent of inspected roofs with less than 1/4" slope	%	100%	100%	92%	24%	85%
13	Average job area (of jobs surveyed and inspected)	SQ	579	178	238	327	59
14	Total job area (of job surveyed and inspected)	SQ	28,379	9,639	5,703	16,679	3,188
15	Total number of returned surveys / Num. of jobs surveyed	#	35 / 50	39 / 54	24 / 24	47 / 51	41 / 55
16	Total number of jobs inspected	#	17	54	24	51	55
17	Total num. of different customers surveyed & inspected	#	25	9	1	5	48
18	Total number of Alpha Inspection Surveys	#	5	1	1	6	1
19	Certification Status	Status	C	C	C	US	C

Note: Under "Certification Status", US stands for "Under Survey" and C stands for "Current"

Table 4, cont'd

Current Alpha Contractor Performance Lines (Summary of All Alpha Contractors)

No	Job	Unit	Overall
1	Overall Contractor Performance	(1-10)	9.8
2	Oldest job surveyed	Years	33
3	Average age of jobs surveyed	Years	9
4	Age sum of all projects that never leaked	Years	2,654
5	Age sum of all projects that do not leak	Years	3,825
6	Percent of customers that would purchase again	%	100%
7	Percent of jobs that do not leak	%	99%
8	Percent of jobs completed on time	%	100%
9	Percent of satisfied customers	%	100%
10	Percent of insp. roofs with less than 5% ponded water	%	99%
11	Percent of inspected roofs with less than 1% deterioration	%	96%
12	Percent of inspected roofs with less than 1/4" slope	%	89%
13	Average job area (of jobs surveyed and inspected)	SQ	332
14	Total job area (of job surveyed and inspected)	SQ	200,905
15	Total number of returned surveys / Num. of jobs surveyed	#	420 / 615
16	Total number of jobs inspected	#	556
17	Total num. of different customers surveyed & inspected	#	255
18	Total number of Alpha Inspection Surveys	#	N/A
19	Certification Status	Status	N/A

Note: Under "Certification Status", US stands for "Under Survey" and C stands for "Current"

Table 5

Yearly Inspection Performance Lines

No	Job	Unit	1991	1993	1995	1996
1	Overall Contractor Performance	(1-10)	N/A	N/A	N/A	N/A
2	Oldest job surveyed	Years	12	14	15	20
3	Average age of jobs surveyed	Years	6	7	6	6
4	Age sum of all projects that never leaked	Years	205	285	585	378
5	Age sum of all projects that do not leak	Years	235	303	665	573
6	Percent of customers that would purchase again	%	100%	100%	100%	100%
7	Percent of jobs that do not leak	%	95%	98%	100%	100%
8	Percent of jobs completed on time	%	100%	100%	100%	100%
9	Percent of satisfied customers	%	98%	98%	100%	100%
10	Percent of insp. roofs with less than 5% ponded water	%	86%	86%	90%	58%
11	Percent of inspected roofs with less than 1% deterioration	%	89%	96%	96%	100%
12	Percent of inspected roofs with less than 1/4" slope	%	48%	49%	58%	38%
13	Total job area (of job surveyed and inspected)	SQ	3,873	4,115	23,627	29,592
14	Total number of returned surveys / Num. of jobs surveyed	#	41 / 66	54 / 71	107 / 142	94 / 102
15	Total number of jobs inspected	#	66	71	142	102
16	Total num. of different customers surveyed & inspected	#	39	40	90	18
17	Total number of different Alpha contractors	#	1	1	1	2

Table 5, cont'd

Yearly Inspection Performance Lines

No	Job	Unit	1997	1998	1999	2000
1	Overall Contractor Performance	(1-10)	9.9	8.6	9.2	9.0
2	Oldest job surveyed	Years	18	26	19	24
3	Average age of jobs surveyed	Years	5	6	8	8
4	Age sum of all projects that never leaked	Years	545	1,527	1,482	774
5	Age sum of all projects that do not leak	Years	643	2,415	1,592	1,540
6	Percent of customers that would purchase again	%	100%	100%	100%	100%
7	Percent of jobs that do not leak	%	100%	99%	100%	99%
8	Percent of jobs completed on time	%	100%	94%	98%	95%
9	Percent of satisfied customers	%	100%	99%	100%	96%
10	Percent of insp. roofs with less than 5% ponded water	%	70%	60%	85%	82%
11	Percent of inspected roofs with less than 1% deterioration	%	97%	85%	97%	89%
12	Percent of inspected roofs with less than 1/4" slope	%	62%	57%	62%	56%
13	Total job area (of job surveyed and inspected)	SQ	36,723	133,695	66,440	136,975
14	Total number of returned surveys / Num. of jobs surveyed	#	130 / 173	388 / 521	230 / 270	193 / 411
15	Total number of jobs inspected	#	173	521	270	411
16	Total num. of different customers surveyed & inspected	#	82	312	99	221
17	Total number of different Alpha contractors	#	3	8	5	8

Table 5, cont'd

Yearly Inspection Performance Lines

No	Job	Unit	2001	2002	2003	2004
1	Overall Contractor Performance	(1-10)	9.0	9.5	9.8	9.5
2	Oldest job surveyed	Years	27	16	29	28
3	Average age of jobs surveyed	Years	10	7	10	9
4	Age sum of all projects that never leaked	Years	1,124	525	1,475	581
5	Age sum of all projects that do not leak	Years	1,575	695	2,574	875
6	Percent of customers that would purchase again	%	100%	99%	100%	100%
7	Percent of jobs that do not leak	%	100%	99%	100%	100%
8	Percent of jobs completed on time	%	100%	97%	100%	99%
9	Percent of satisfied customers	%	99%	96%	100%	100%
10	Percent of insp. roofs with less than 5% ponded water	%	66%	69%	96%	82%
11	Percent of inspected roofs with less than 1% deterioration	%	97%	97%	97%	97%
12	Percent of inspected roofs with less than 1/4" slope	%	47%	47%	69%	73%
13	Total job area (of job surveyed and inspected)	SQ	56,042	52,246	107,529	71,977
14	Total number of returned surveys / Num. of jobs surveyed	#	167 / 204	107 / 147	255 / 356	100 / 142
15	Total number of jobs inspected	#	204	147	356	142
16	Total num. of different customers surveyed & inspected	#	51	96	161	79
17	Total number of different Alpha contractors	#	4	3	8	4

Table 5, cont'd

Yearly Inspection Performance Lines

No	Job	Unit	2005	2006	2007	2008
1	Overall Contractor Performance	(1-10)	9.3	9.5	9.8	9.5
2	Oldest job surveyed	Years	21	26	26	5
3	Average age of jobs surveyed	Years	6	8	9	3
4	Age sum of all projects that never leaked	Years	424	1,186	925	135
5	Age sum of all projects that do not leak	Years	518	1,786	1,406	168
6	Percent of customers that would purchase again	%	83%	100%	100%	100%
7	Percent of jobs that do not leak	%	100%	100%	100%	100%
8	Percent of jobs completed on time	%	100%	99%	100%	100%
9	Percent of satisfied customers	%	100%	100%	100%	100%
10	Percent of insp. roofs with less than 5% ponded water	%	100%	100%	97%	100%
11	Percent of inspected roofs with less than 1% deterioration	%	98%	96%	95%	100%
12	Percent of inspected roofs with less than 1/4" slope	%	65%	76%	91%	96%
13	Total job area (of job surveyed and inspected)	SQ	42,500	122,347	74,754	30,357
14	Total number of returned surveys / Num. of jobs surveyed	#	126 / 170	234 / 348	160 / 267	62 / 65
15	Total number of jobs inspected	#	170	348	241	65
16	Total num. of different customers surveyed & inspected	#	69	141	171	7
17	Total number of different Alpha contractors	#	4	7	6	2

Table 5, cont'd

Yearly Inspection Performance Lines

No	Job	Unit	2009	Overall
1	Overall Contractor Performance	(1-10)	9.7	9.3
2	Oldest job surveyed	Years	33	33
3	Average age of jobs surveyed	Years	11	8
4	Age sum of all projects that never leaked	Years	2,081	7,046
5	Age sum of all projects that do not leak	Years	2,999	10,207
6	Percent of customers that would purchase again	%	100%	100%
7	Percent of jobs that do not leak	%	99%	100%
8	Percent of jobs completed on time	%	100%	98%
9	Percent of satisfied customers	%	100%	99%
10	Percent of insp. roofs with less than 5% ponded water	%	100%	84%
11	Percent of inspected roofs with less than 1% deterioration	%	97%	93%
12	Percent of inspected roofs with less than 1/4" slope	%	88%	65%
13	Total job area (of job surveyed and inspected)	SQ	156,922	588,871
14	Total number of returned surveys / Num. of jobs surveyed	#	283 / 390	1,307 / 2,000
15	Total number of jobs inspected	#	357	1,974
16	Total num. of different customers surveyed & inspected	#	101	988
17	Total number of different Alpha contractors	#	8	24

Table 6

Dallas Urethane Performance Lines

No	Job	Unit	2004	2006	2009
1	Overall Contractor Performance	(1-10)	9.5	9.8	9.8
2	Oldest job surveyed	Years	18	20	23
3	Average age of jobs surveyed	Years	10	9	12
4	Age sum of all projects that never leaked	Years	283	241	303
5	Age sum of all projects that do not leak	Years	392	284	425
6	Percent of customers that would purchase again	%	100%	100%	100%
7	Percent of jobs that do not leak	%	100%	100%	100%
8	Percent of jobs completed on time	%	100%	100%	100%
9	Percent of satisfied customers	%	100%	100%	100%
10	Percent of insp. roofs with less than 5% ponded water	%	53%	100%	100%
11	Percent of inspected roofs with less than 1% deterioration	%	93%	98%	100%
12	Percent of inspected roofs with less than 1/4" slope	%	72%	18%	100%
13	Total job area (of job surveyed and inspected)	SQ	280	580	579
14	Total number of returned surveys / Num. of jobs surveyed	SQ	15,412	28,982	28,379
15	Total number of jobs inspected	#	38 / 55	32 / 50	35 / 50
16	Total num. of different customers surveyed & inspected	#	55	50	17
17	Total number of different Alpha contractors	#	44	34	25

Table 7

IRC Performance Lines

No	Job	Unit	2004	2007	2009
1	Overall Contractor Performance	(1-10)	9.9	9.9	9.8
2	Oldest job surveyed	Years	28	26	33
3	Average age of jobs surveyed	Years	14	16	19
4	Age sum of all projects that never leaked	Years	242	366	388
5	Age sum of all projects that do not leak	Years	426	598	800
6	Percent of customers that would purchase again	%	100%	100%	100%
7	Percent of jobs that do not leak	%	100%	100%	100%
8	Percent of jobs completed on time	%	100%	100%	100%
9	Percent of satisfied customers	%	100%	100%	100%
10	Percent of insp. roofs with less than 5% ponded water	%	100%	100%	100%
11	Percent of inspected roofs with less than 1% deterioration	%	100%	100%	92%
12	Percent of inspected roofs with less than 1/4" slope	%	100%	95%	94%
13	Total job area (of job surveyed and inspected)	SQ	73,541	68,947	77,798
14	Total number of returned surveys / Num. of jobs surveyed	SQ	3,897,694	3,929,973	3,889,887
15	Total number of jobs inspected	#	31 / 53	37 / 57	44 / 51
16	Total num. of different customers surveyed & inspected	#	53	57	51
17	Total number of different Alpha contractors	#	22	22	19

Table 8

Wattle & Daub Performance Lines

No	Job	Unit	2003	2006	2009
1	Overall Contractor Performance	(1-10)	9.9	9.8	9.8
2	Oldest job surveyed	Years	24	24	27
3	Average age of jobs surveyed	Years	14	16	18
4	Age sum of all projects that never leaked	Years	447	518	785
5	Age sum of all projects that do not leak	Years	549	584	863
6	Percent of customers that would purchase again	%	100%	100%	100%
7	Percent of jobs that do not leak	%	100%	100%	100%
8	Percent of jobs completed on time	%	100%	100%	100%
9	Percent of satisfied customers	%	100%	100%	100%
10	Percent of insp. roofs with less than 5% ponded water	%	100%	100%	100%
11	Percent of inspected roofs with less than 1% deterioration	%	98%	100%	98%
12	Percent of inspected roofs with less than 1/4" slope	%	38%	98%	88%
13	Total job area (of job surveyed and inspected)	SQ	15,077	20,535	19,489
14	Total number of returned surveys / Num. of jobs surveyed	SQ	768,945	862,471	993,953
15	Total number of jobs inspected	#	41 / 53	49 / 53	49 / 51
16	Total num. of different customers surveyed & inspected	#	53	53	51
17	Total number of different Alpha contractors	#	10	6	6

Uses of Performance Information in the Procurement of High Performance Materials

There are various uses of performance information in procuring best value materials/systems:

1. Alignment of performance with a unique requirement.
2. Use of performance information instead of minimum technical qualifications.
3. Specification of a installed system with a quality control/risk management system that is more effective and efficient than a warranty.

Using Performance Information to Align Requirement and Vendor Service

The performance information database and performance lines of contractors minimize the decision making of a client and their design representative. For example, if a client needed a high performance large roof system installed quickly, the client will likely pick contractor H from Table 4. Contractor H has 33 years maximum performance / 19 years average performance, and has a maximum installed roof size of 76,272 SF (largest roof.) They also have no currently leaking roofs, their performance rating is 9.8 (max is 10.0) and they have 100% customer satisfaction.

However, if the client had a smaller roof, over a historical library, where quality and the risk of leaking have to be completely minimized, the client would most probably select contractor E. The difference with contractor E is the Age Sum of Roofs that Never Leaked (ASRNL; add the number of years of all the roofs that never leaked of clients who were satisfied of roofs that never leaked for any reason.) It is important to realize that as roofs get older, they have a greater probability of leaking. Roofs will not last forever. Contractor E's ASRNL is 785 years. Contractor E has a performance rating of 9.8, 27 years maximum/ 18 years average rating, and

19,489 SF average roof size. Contractor E is a smaller contractor who has performed over a long period of time. When a contractor is smaller they tend to do better quality work. As they get larger, they get faster and do much larger work quicker. Contractor E will probably be more expensive than Contractor H, but for this client, Contractor E will be a better value.

Using Performance Information in Place of Minimal Standards

The traditional way to specify a product is using minimal technical specifications. Many specifiers do not realize that minimum standards, such as ASTM, are created using manufacturer-provided data on their products, and the minimum ASTM specification is normally the lowest value of the participating manufacturers. The minimum ASTM standard has no documented or logical relationship to the expected length or level of performance. Even for a high performance product, in most cases, it is unknown which characteristic or combination of characteristics is most influential in providing the high performance installed product. Many of the current standards in the SPF industry originated with Kashiwagi (1999), who readily admits that at the time he set many of the SPF installation standards (minimum ½ inch SPF pass, one pass SPF roof system) he knew very little about the SPF mechanisms of performance and failure. He proposed the standards based on inspection results and practices of high performing contractors. Kashiwagi proposed a deductive approach to price based specifications:

1. Require the contractor and manufacturer to show documented proof of level/quality of performance and length of proven performance.
2. Require the contractor and manufacturer to provide their scope of work which includes a risk management plan and risk management report.
3. Require a risk management / quality control system for the length of the expected service period which includes every other year inspections by a third party.
4. Require a risk management plan and a weekly risk reporting system during the roofing project that identified all deviations on a project from the contractor's proposed baseline scope and schedule.
5. Require an ongoing performance assessment system of the manufacturer and their contractors.

The above are risk management principles. By definition, performance is risk management. Risk can only be determined once a level of performance is identified. If risk cannot be minimized, the client or end user will not have any way to mitigate their risk. It is safe to assume that if the manufacturer lacked the above risk management systems, they also have no way to manage the risk of nonperformance. Therefore, their cost would be higher, their profits lower, and they will become a manufacturer of commodity products who transferred the risk to the clients who bought the installed systems. The best way for manufacturers to transfer the risk to the end user would be to treat their contractors as their buyer/customer, and give them a warranty to deliver to the end users to minimize any liability. This is the traditional roofing delivery system which transfers the risk to the end user. A high performance manufacturer uses a specification in the price based environment which includes the risk management program before, during, and throughout the service period of the roofing system.

Manufacturer's Risk Management System Case Study

The Dallas Independent School District (DISD) had used SPF roof systems in the past, but in 2000, had decided to discontinue any use of the system due to repeated nonperformance of the SPF systems (Smith, 2010). However, an introduction to the Alpha documented performance, the risk management approach of the Alpha system, and a best value procurement model which would ensure that high performance contractors would install the systems, convinced DISD to compete the Alpha SPF roof system against the more traditional built up roof (BUR) and modified bitumen systems in a best value Performance Information Procurement System (PIPS) test. After procuring three SPF roof systems out of ten roof projects based on performance, DISD decided to procure the Alpha system as a best value alternative system in their bond programs.

Over the next five years, DISD procured over 3M SF of the Alpha roofs (45 mil average) or a lower costing Permathane (35 mil average thickness) coated SPF systems. There were only four Alpha contractors competing for the work and when the 2005 Bond Program was initiated, and the four contractors had a difficult time meeting the demand. A non-Alpha (not measured, not using the performance documented Alpha system), also entered into the projects as an “or-equal”, and DISD quickly saw the difference between the work, resulting in ensuring that all future SPF roof work is done by Alpha qualified contractors.

Some of the roof installations may have been done under suboptimal conditions due to the schedules of the roof installations. These conditions included inclement or cold weather and moisture saturated roofing insulation or decks. During the same time the SPF formulation was changed due to new requirements of minimizing the CFC blowing agent. With the radically increased work load caused by the DISD bond program demand for SPF roofing, the changing of the SPF formulation, and the constraints caused by the low price awards used by the general contractors (SPF roofing contractors were subcontractors) led to minimal SPF blistering (less than 1% of total roof areas.)

Table 8 shows the different Alpha contractors doing work at DISD. None of the contractors had more than 1% blistering, and the average blistering rate was 0.1%. The 71 roofs seemed to be installed correctly.

Table 9 shows the blistering areas on the DISD roofs. Even though the SPF blisters were minimal, DISD wanted the blistering repaired. The contractors initially requested the manufacturers (both Neogard and the SPF manufacturers) to assist in paying for the repairs. They contended that it was improper materials that caused the problem. Neogard resisted paying for the repairs due to an agreement with the SPF manufacturers that they would fund SPF blistering problems. At the same time the SPF manufacturers maintained that it was improper application that led to the blistering. PBSRG proceeded to inspect the roofs to identify the potential cause of problems.

Table 8

Summary of DISD Alpha Contractor Results

Contractor	Number of Roofs	Total Roof Area	Average Age	Average Percent Blistered	Average Percent Repaired	Percent of Blisters & Repairs*
Alpha Contracting	44	1,908,045	4.0	0.1%	0.1%	0.1%
Dallas Urethane	2	192,000	4.4	0.1%	0.4%	0.5%
Longhorn	3	108,500	3.9	0.1%	0.3%	0.4%
Phoenix1	20	765,360	4.9	0.3%	3.2%	3.5%
S & J Contractors	2	49,500	2.9	0.6%	0.5%	1.1%
Average	71	3,023,405	4.2	0.1%	0.9%	1.0%

*This the sum of the average percent of blistered and repaired areas

Table 9 also shows the blistering results for the ten worst blistered roofs. The ten worst blistered roofs seem to have poorer application than the rest. Table 10 shows top ten most blistered schools.

Table 9

DISD SPF Roof System Performance

No	Criteria	Unit	Overall	Top Ten*	Top Five*
1	Percent of roof area blistered	%	0.1%	0.3%	0.2%
2	Percent of blistered area with large blisters	%	31%	42%	35.3%
3	Percent of roof area blistered & repaired	%	0.9%	5.4%	6.9%
4	Average Blister Size	SF	1.9	2.3	1.8
5	Average Large Blister Size	SF	7.7	7.6	6.5
6	Average Repair size	SF	15.0	17.4	15.9
7	Minimum slit sample thickness	Mils	23	17	15
8	Average slit sample thickness	Mils	35	31	30
9	Average of Age	Years	4.2	5.3	4.8
10	Average roof size	SF	42,583	45,974	52,872
11	Total roof area inspected	SF	3,023,405	459,744	264,360
12	Number of roofs inspected	#	71	10	5

*Top Roofs Blistered & Repaired (SF)

Table 10

Top Ten Most Blistered Schools

No	Criteria	Unit	Percent Blistered & Repaired
1	Miller ES	%	20%
2	Withers ES	%	8%
3	DeGoyler ES	%	5%
4	Hill MS	%	5%
5	Harlee ES	%	5%
6	Bushman ES	%	4%
7	Pease ES	%	4%
8	Foster ES	%	3%
9	Macon ES	%	3%
10	Russell ES - Old Admin Bldg	%	2%

Figure 3 shows the percentage of blister contribution from the last 8 years. It seems as though there is no pattern. The authors assume that since there is no constant increase or decrease of blistering over time, blistering may be caused by the large demand in SPF roofing, resulting in a spike of blistering in 2004.

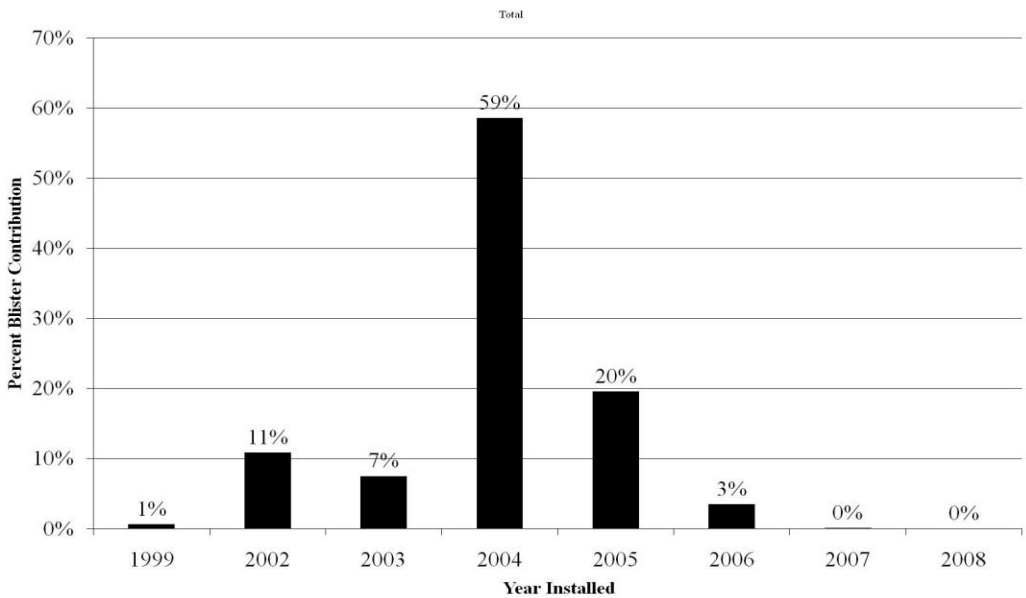

Figure 3: Percentage Blister Contribution by Year

Figure 4 shows that the percentage of blistering of roofs is higher in the first couple of years (1999-2004.) Figure 5 verifies that in 2005, there was an increase in the amount of roof installed

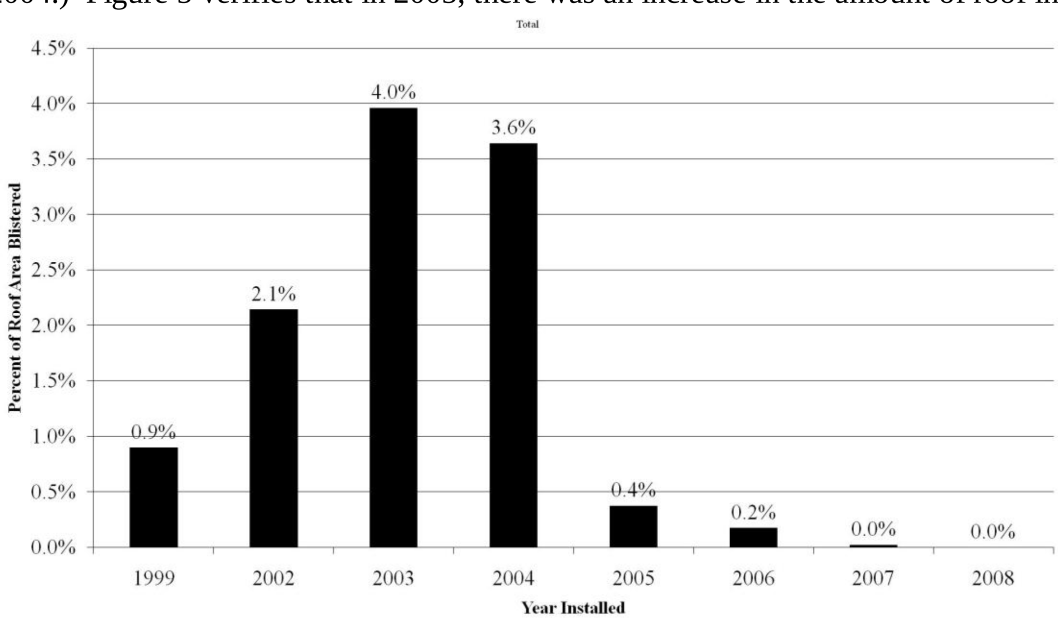

Figure 4: Percent Roof Area Blistered by Year

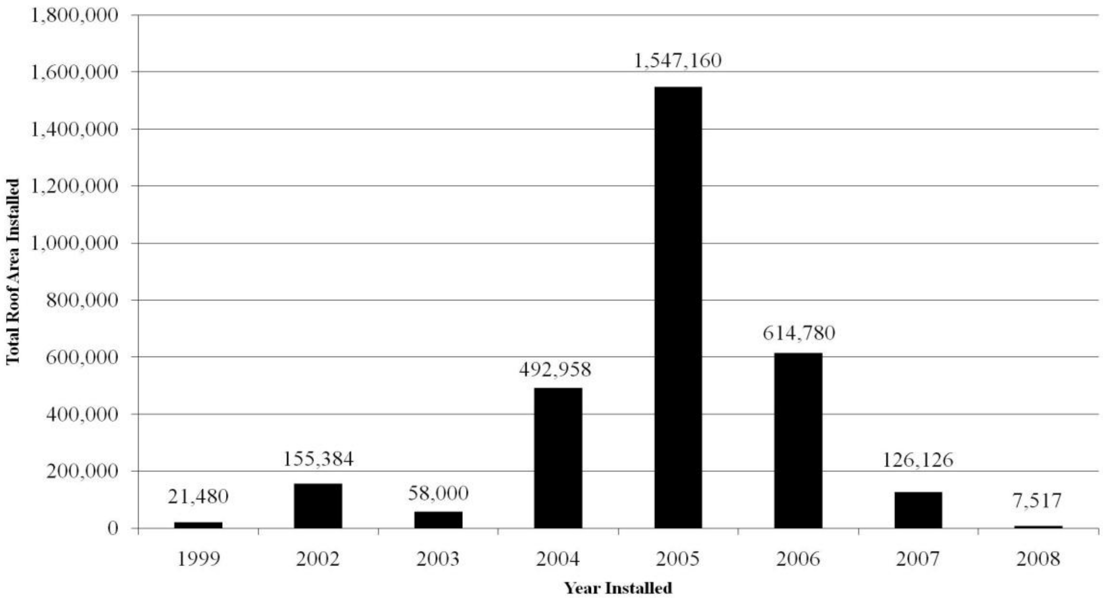

Figure 5: Roof Area Installed by Year

Figures 6 and 7 show that blister and repair contribution and blister and repair percentage of total roof area are high in June and October. Blister contribution is also high in April and August.

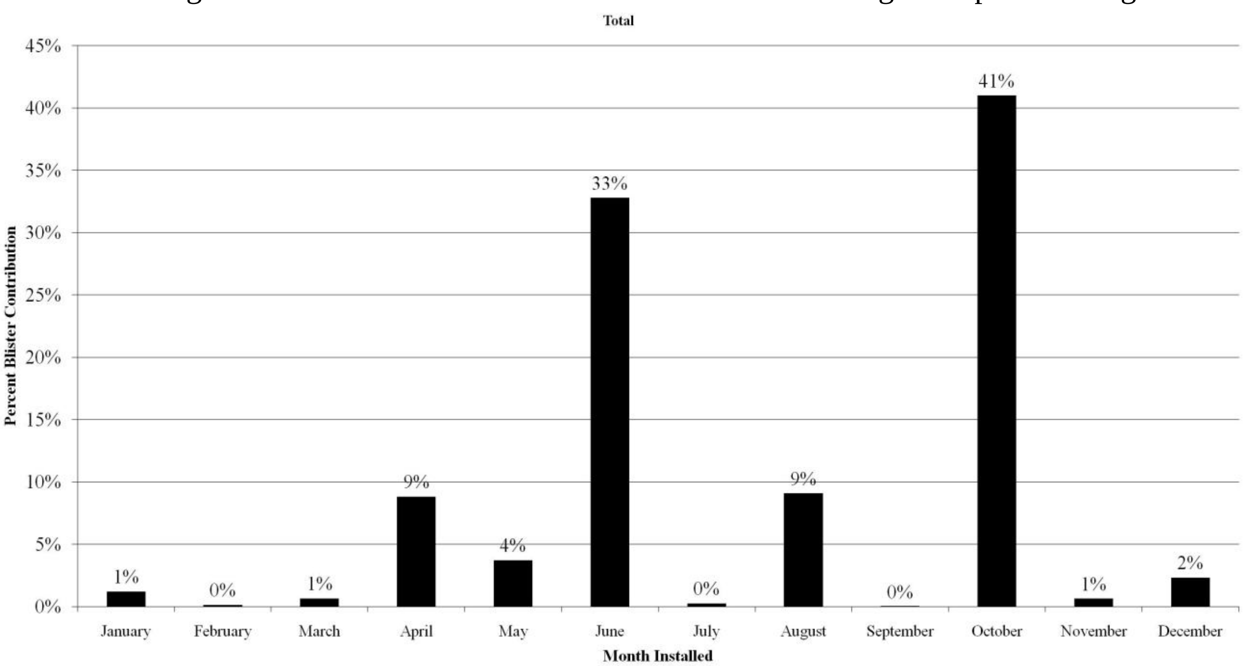

Figure 6: Percentage Blister and Repaired Contribution by Month

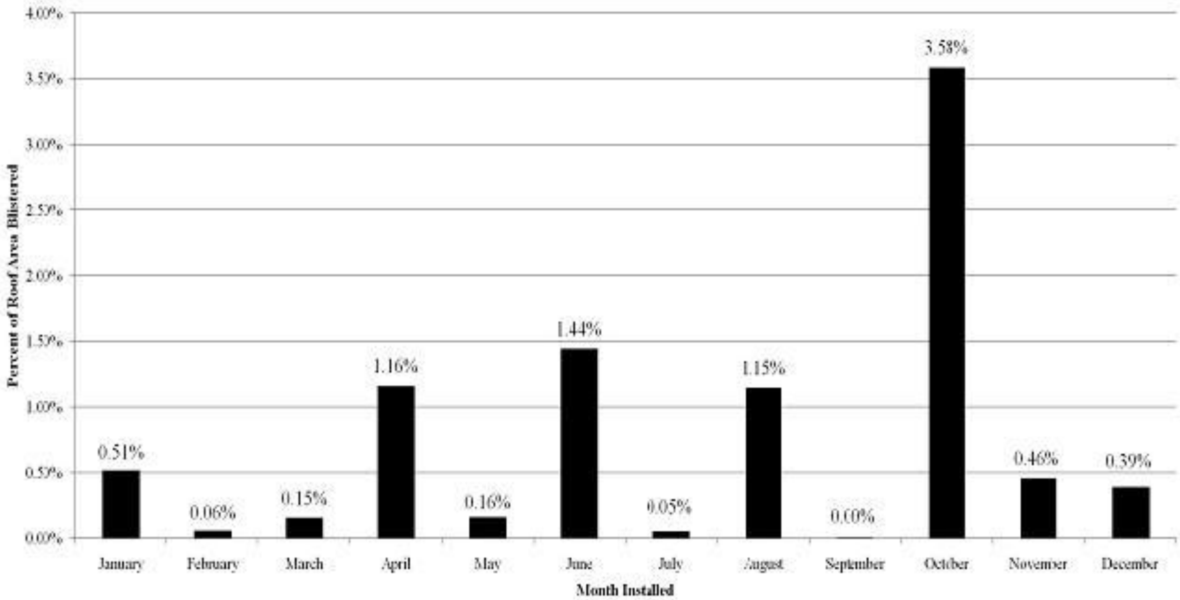

Figure 7: Percent of Roof Area Blistered and Repaired by Month

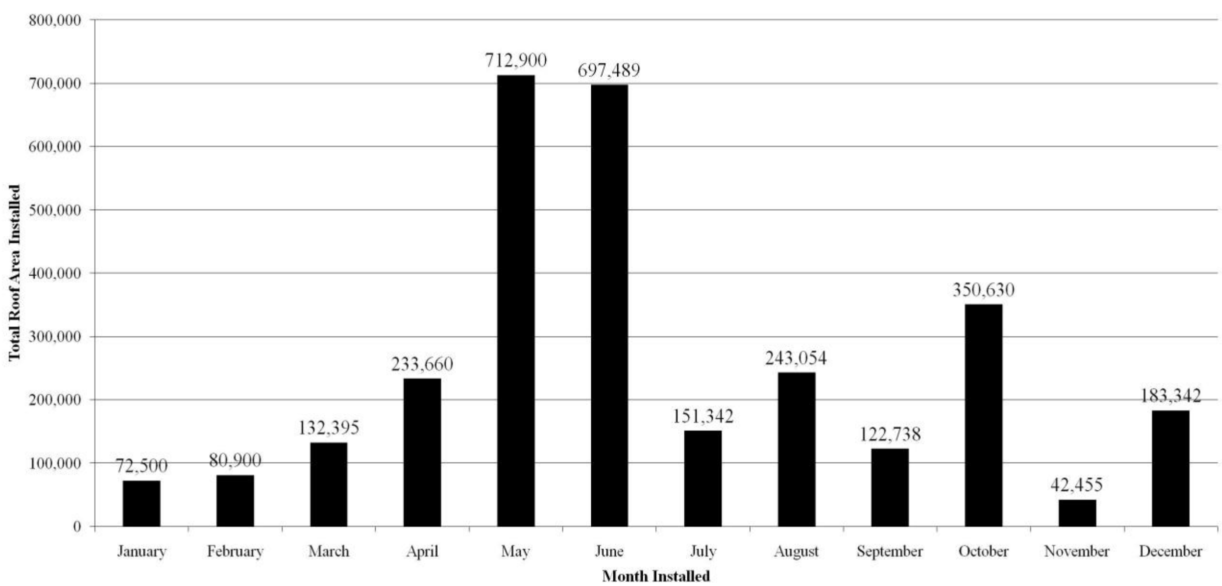

Figure 8: Roof Area Installed by Month

The data collection survey results showed that:

1. A large percentage of the blisters were on roofs installed during the colder weather, when SPF roof installation performance may be marginal.
2. The SPF roof system may be more difficult to apply, however, the data shows no substantial increase in blistering is caused by the transition of the SPF formulations.
3. Roofs with severe performance issues may have be related to a SPF manufacturer who had suboptimal SPF quality. It shows tremendous risk of using nonperforming materials.

The data also shows that the manufacturers were probably not responsible for the blistering due to poor materials. It seems as though the upswing in work resulted in contractors doing the work too quickly and not installing performance systems. The contractors also seemed to be pushing the envelope of doing work too late in the year. Because of the Alpha program and the performance information, the contractors agreed to fix their problems. The DISD representative, after reviewing the performance information, also agreed with the results of the performance survey. DISD has saved a minimum of $150,000 of repair costs because the contractors fixed their own problems. This is not the standard operating procedure for contractors to fix their problems at DISD roofs. It is even more interesting that a couple of the contractors who do not do a lot of DISD roofs, also fixed their blisters showing to the manufacturer that the contractors actually bought into the idea of performance, and were doing repairs because that is what a performer does. A major reason that the DISD roofing representative has stayed with SPF roof systems is the risk management/quality control system of the Neogard Alpha roofing system.

Samuel High School was not included in Table 8b & 9 and Figures 3-8. The area of the replaced roof was 147,750 SF which would have skewed the data.

Best Value Education

Neogard was the first construction manufacturer who perceived that the sponsoring Best Value education would assist in identifying high performance clients who would procure roofing systems in the best value environment. Presentations were made to many of the industry organizations in the U.S: International Facility Management Association (IFMA,) Project Management Institute (PMI,) Institute of Supply Chain Management (ISM,) American Society of Health Engineers (ASHE,) and the National Institute of Government Purchasers (NIGP) chapters to educate client representatives on value and performance. From the Alpha program sponsored client education, Neogard had tremendous successes with identifying the following clients who procured value based on documented performance information that resulted in a tremendous amount of success for Neogard's high performance products using high performance vendors (PBSRG, 2009):

1. 1997 ($2.8M) - The United Air Lines Maintenance, roofing and related waterproofing and flooring projects in 1997 and redoing the floors 11 years later: $2.8M.
2. 1998 – 2000 ($1.16M) - State of Hawaii roofs, Alpha system applications.
3. 1999 ($2.38M) - PECO Energy Facilities roofing.
4. 2002 ($1.9M) - Dallas Independent School District test case; roofing systems.
5. 2005 - Dallas Independent School District Bond program roofs (3 million square feet of Alpha and Permathane systems.)
6. 2005 - L3 facilities, 1.2M square feet, where an Alpha contractor switched over from unreliable polyurea fast-set coating to the more reliable Permathane Alpha coating system due to documented performance information and Alpha system risk minimization capability.
7. 2005 ($0.35M) - US. Coast Guard direct bond roof Alpha system without the SPF.
8. 2005 ($1.46M) - US Army Medical Command roof at Fort Polk
9. 2006 - Schering Plough facilities in New Jersey used best value Alpha systems to install the Alpha system on their manufacturing plant roofs.
10. 2006 ($0.45M) - US Army Medical Command project roof at Dugway
11. 2009 ($1.6M) - Kansas Marine building envelope roof
12. 2010 ($0.5M) - US Army Medical Command Roof at Fort Rucker: 70,000 SF

All the above clients were influenced by the documented performance, and risk management program. The high number of projects over the ten years of the best value and Alpha program assisted in development of the Best Value program at PBSRG.

Moving Forward: Risk Management Program

Contractors who were required to fix their SPF roof problems at DISD reacted in the following manner:

1. Contractors should be required to fix their problems in a performance based system.
2. Pricing of future roof projects will consider the risk caused by general contractor's schedule requirements and the potential for moisture in the existing deck.
3. Contractors will be much more conservative of meeting the minimum environmental requirements required by SPF application.

The majority of contractors at DISD also proposed that they would inspect the roofs more often than the Alpha program requirement of every other year, especially the roofs that may have more issues. This contractor behavior is one of the objectives of the Alpha program:

1. Contractors reinspect roofs at least once a year.
2. Contractors give the client proactive updates on their roof installations.

Manufacturers and contractors have a difficult time being proactive in addressing risk. Neogard is the only manufacturer in the SPF industry who has a proactive performance based methodology in minimizing the risk of nonperformance once roof systems have been installed. However, the best value risk management system which assists the contractors to minimize the risk before and during installation has yet to be successfully implemented. The latest change in the Alpha program is to have the following implemented in the Alpha specification and roof installation process:

1. A risk management plan which is agreed to by client, contractor, and manufacturer before the notice to proceed is issued on the roof project.
2. A weekly risk report, which tracks all potential risks and deviations to a roof installation during the duration of the project.

Risk Management Plan

The risk management plan is a plan that minimizes the risk that the contractor does not control to include:

1. The expectation of the client which exceeds the contract technical scope.
2. The risk to the performance of the roofing system that was poorly defined or not included in the project scope.
3. The reaction to uncontrollable elements such as weather, SPF material quality, equipment malfunctions.

4. Concerns of the client and general contractor including timing, project schedule, interface between roof and other building elements.

The risk management plan requires the following:

1. A meeting between all participating parties before the project starts to identify all risks and concerns.
2. The contractor’s method of managing and minimizing the risks and concerns.
3. The approval of all other parties of the risk management plan.

The risk management plan then becomes the last page of a weekly risk report. The weekly risk report includes the following elements and is submitted once a week to the roofing manufacturer’s representative, the client’s project manager, the procurement agent, and the general contractor:

1. A list of all contacts of the major participants with their contact information.
2. A milestone schedule and the actual schedule.
3. A tracking of all change orders/modifications on the project that causes a deviation of time or cost.
4. A short explanation of every risk, and the management of the risk that leads to the modification.
5. A printout status report sheet that captures the status of the project.
6. An updated risk management plan.

Each item is on its separate page on the spreadsheet. The spreadsheet is managed by the contractor, updated weekly, and sent to the critical participants on the project. Clients such as the University of Minnesota and the U.S. Army Medical Command, have another spreadsheet that collects individual project risk reports and automatically analyzes the risk information and produces an overall Director’s Report of the riskiest projects. This Director’s Report can handle up to 300 different projects without much effort. The use of the Director’s Report is a method to manage a tremendous amount of projects with very little effort, forcing contractors to be accountable for the projects. The risk management system using the risk management plan, the weekly risk report, and the Director’s report, has minimized the amount of cost deviations of projects by 170% for the U.S. Army Medical Command. A manufacturer with high performance product/systems, and using a risk management program that includes tracking project performance information, a risk management plan, weekly risk report, and a Director’s Report, can offer the best value to customers requiring roofing system assistance.

Conclusion

Neogard has successfully identified itself as the manufacturer of the highest performing elastomeric coating for a sprayed polyurethane foam (SPF) roofing system in environments requiring durability and impact of hail environments. They have implemented a performance based program that measures the performance of not only their coating, but the contractors installing the SPF roofing system to optimize the performance of the installed SPF system. The performance based contractor program is the only performance based program in the construction industry, where contractors are allowed in and eliminated based on performance requirements of end users/facility owners. The end user customer satisfaction includes high percentages of roofs not leaking (98%) and customers satisfied (98%). Neogard has also moved the performance measurements into the areas of flooring, wall coatings, and waterproofing.

Neogard has used the construction industry structure (CIS) business approach to sell its products in all three construction industry environments. They have set the Alpha program in the best value environment, where they capture the high performance resulting from alignment of the high performing end user, manufacturer product, and contractor. They then use the marketing of high performance numbers and distribution of products in the price based marketplace to minimize liability and the risk of nonperformance. They also use the performance information in the negotiated or sole source environment to ensure the clients that they are getting the highest performance. In all three environments, they should use the weekly risk report to minimize risk and liability.

Neogard has tested out their performance based contractor program on a large client, the Dallas Independent School District (DISD.) DISD and Neogard have both benefited by high performing contractors fixing over 30,000 SF of blisters (minimal $150,000.) Some of the contractors do not have DISD as their major clients, and these contractors also fixed their problems. Currently the 80 SPF roofs at DISD do not leak and are trouble free.

Recommendations for Further Research

The authors make the following recommendations to optimize Neogard or other manufacturer's high performance products/installed systems:

1. Study the use of performance information to determine "or equal" products instead of minimal technical measurements, physical properties or standards.
2. Research the possibility of requiring manufacturers of construction products to minimize risk created before, during, and after installation with a risk management system based on performance information instead of warranties.
3. Study the proposal to require manufacturers and contractors to constantly measure the performance of their products in terms of customer satisfaction, not leaking, protection of structures, performing without defects, and the capability to respond to issues if they occur.
4. Study the risk management programs of manufacturers and contractors to document deviations to product installation and scope in terms of concerns, costs, time, and expectations.

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