

# Price Based Environment of Design and Engineering Services

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Design Services have not met the value and expectations of the clients and their project managers. A previous research project studied the impact of the price based award environment on construction practices, and this research proposes that designers' current practices and expectations are also price based and not performance based as perceived by many due to the qualifications based system [QBS] approach. The authors also propose that the qualification-based system [QBS] is a price based system and should be replaced by a best value approach, which includes a best value selection process such as the Performance Information Procurement System (PIPS.) The proposed design model will give control and risk management capability back to designers by having the designers utilize expertise, create transparency utilizing a weekly risk report (WRR) and a risk management plan (RMP.) The new model utilizes the expert's expertise to create transparency, giving the advantage to the higher performing professionals. The researchers interviewed over 400 professionals to validate the concepts of the best value approach for the design community.

**Keywords:** Qualification Based System [QBS]; Best Value; Performance Information Procurement System.

## Introduction

There is a great deal of inefficiency throughout the A/E/C (Architectural, Engineering and Construction) industry (FMI et al. 2010). Many believe the design professional to be the major source of risk and inefficiency, ultimately leading to poor delivery of construction services (Tucker, 2003, FMI et al. 2005). However, there may be multiple issues causing poor performance throughout the design and construction industry (Rubin, 2005). One of these issues may be the procurement system itself (Sullivan, Kashiwagi, & Kashiwagi, 2009).

Since the enactment of The Brooks Act (Public Law 92-582 for Federal Procurement) in 1972, the majority of A/E design services, for public projects, have been procured through QBS (Qualification Based Selection). Qualifications have led to minimum requirements and non-transparency resulting in a price based environment.

Information Measurement Theory (IMT) has been developed over the past 20 years (Kashiwagi, 2014), it explains the reason for the issues being experienced in the A/E/C industry. IMT identifies that natural laws govern reality. Some of the natural laws include:

1. Every event (anything that takes time in reality) starts with unique initial conditions and ends in unique final conditions.
2. The unique initial conditions are always related to the unique final conditions.
3. Over time, natural laws show how the initial conditions turn into the final conditions.
4. It is easier to use hindsight to identify how the initial conditions turned into the final conditions.

Another model, the Kashiwagi Solution Model (KSM), identified the characteristics of a transparent environment (Kashiwagi, 2014). A transparent environment is one where:

1. Things are simple and clear (everyone can understand or see the future outcome).
2. Decision making is minimized due to the ease of understanding or seeing the future outcome.
3. Different entities can be easily differentiated.

By definition, in a non-transparent environment the following conditions exist:

1. Relationships are very important.
2. Performance metrics are not used.
3. Decision making is increased.
4. Management, direction and control are used to minimize risk.
5. Expertise is not utilized and expertise does not have sustainable value.
6. Experts are treated as commodities.

IMT and KSM are the basis of the Best Value (BV) approach. The BV approach development has the following characteristics:

1. 21 year research program.
2. \$13.5M funding.
3. 1700+ tests of the principles.
4. 98% customer satisfaction rate.
5. Testing in 31 states in the U.S. and 5 different countries besides the U.S.

Based on the concepts of IMT, KSM and best value research, the traditional AEC environment is not transparent. The environment is not conducive to increasing the value of the AEC expertise. Relationships and trust between clients and vendors are very important. Clients will utilize management, direction and control of the AEC services to minimize the risk of nonperformance. The AEC vendors will become more reactive, utilizing relationships to obtain projects. Accountability will be minimized. These movements will commoditize the AEC industry.

### **Problem Statement**

By observation and documentation, the delivery of design services through QBS (Qualification Based Selection) does not always deliver the most expert and performing consulting design professionals. The authors propose that the procurement process itself may be the cause of poor designer/professional engineering performance (Sullivan, Kashiwagi, & Kashiwagi, 2009). As a

result, design professionals are not being held accountable for delivering designs that meet the expectations (on time, on budget and minimized change orders) of the client (Touran, 2006; Tucker, 2003). Design performance has deteriorated, has not met the expectations of the client/user, and has minimized the professionalism and importance of designers (FMI et al. 2010, FMI et al. 2005, Egan 1998, FMI et al. 2004).

### **Hypothesis**

Owners can improve design and construction performance by improving the selection and delivery process of professional services. Design professionals (DP) need to move to a best value environment to increase the value of expertise, professionalism and performance. The current QBS environment for DPs is an inefficient, price based, and relationship based environment.

### **Methodology**

To validate the hypothesis the following steps will be performed:

1. Research literature to verify inefficiencies of existing conditions and how those inefficiencies hamper the design professional's performance.
2. Use deductive logic to demonstrate that design professionals currently work in a price based environment and need to move into a best value environment.
3. Validate the concepts of IMT, KSM and Best Value by conducting a survey amongst A/E/C Professionals.

### **Confirming the Price Based Environment of Designers**

In today's construction industry, design, engineering, and construction entities have become commodities, which are often misaligned. The selection of the lowest responsible bidding contractor has increased the risk of the client/owner (Kashiwagi et al. 2004, Sullivan et al. 2006, Sullivan et al. 2009). Owners try to protect themselves by employing legal representation. Facilitators, mediators, arbitrators, judges, juries, special masters, and neutral advisors are also often major players of a project. Indemnification provisions are longer than the scope of services in some service agreements. The party least prepared to control risk is often contracted to do so (Berman, 2003).

A second problem with today's professional design environment is that it is relationship based and not performance based. Architects and engineers are often hired based on relationships. In 2007, SMPS conducted a survey where almost 60 percent of the respondents said that key client relationships are in jeopardy if a particular staff member retires or leaves. Relationships are important to owners and architects, resulting in AIA contracts protecting and preserving relationships during disputes (Berman, 2002).

A third issue in today's design-construction environment is that architectural, engineering and contracting services are being treated as commodities (Mrowiec 2003, Markus 1997, Serant 2003). For example, Maricopa County (Arizona) has considered changing its procurement code. The proposed amendment of the Maricopa County Procurement Code of September 2009 would

consolidate procurement functions into the Department of Materials Management where commodities are purchased. J. Burnett (2009), Executive Director of ACEC of Arizona, stated, “What this means is, if adopted, ‘procurement’ for engineers, architects and contractors would go through Materials Management...” ACEC of Arizona is adamantly opposed to taking the procurement of professional engineering services from the engineering experts and placing this function in the hands of procurement officers who buy commodities.”

### The Construction Industry Structure (CIS)

The construction industry consists of project owners, contractors and design professionals. The Construction Industry Structure (CIS) (Figure 18.1) segments any industry based on performance and competition.

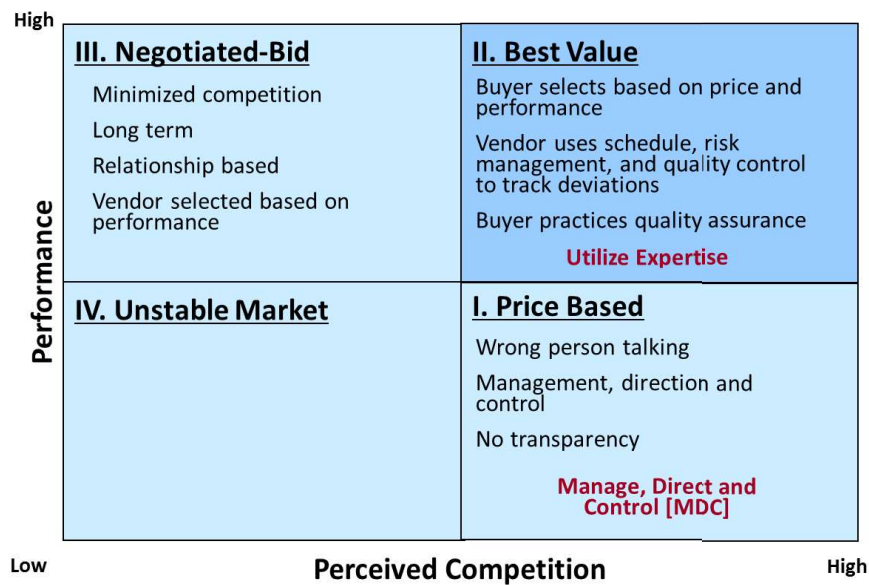


Figure 18.1: Construction Industry Structure (Kashiwagi, 2014)

The price-based environment includes the following characteristics (Kashiwagi, 2014):

1. Projects being awarded based on price, relationships, and the designers/contractors being perceived as commodities.
2. The client’s representative directs and controls both design and construction.
3. There is no transfer of control and accountability to the vendors.
4. Designers use minimum standards to identify requirements.
5. The minimum standards are turned to maximums by the vendors due to the price-based environment and driven downward by vendors (Figure 18.2).
6. Vendors become reactive and do as directed.
7. Contractors who utilize expertise, manage and minimize risk and who are the better value when considering total project cost, become less competitive (Figure 18.3).

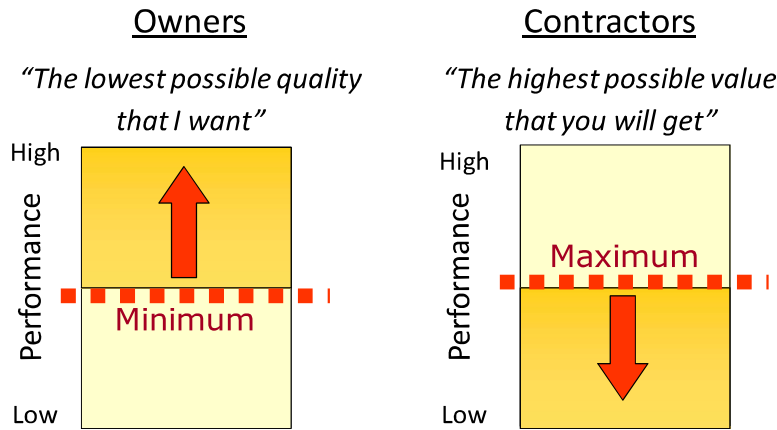


Figure 18.2: Min/Max Dilemma

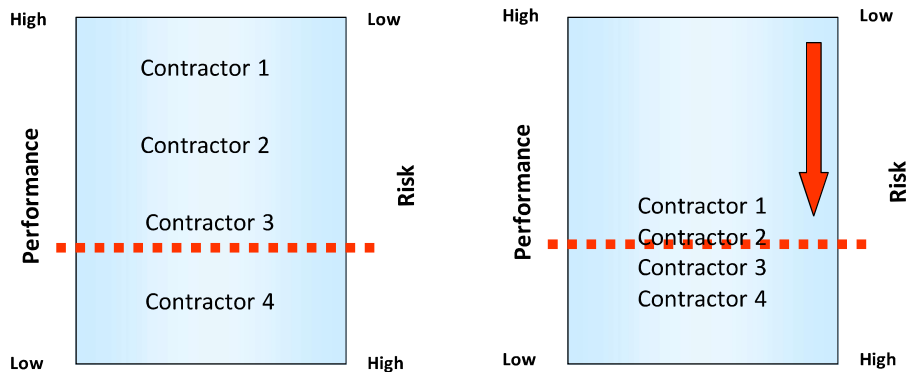


Figure 18.3: Price-Based Award

In the best value environment, risk is minimized through transparency by the best value, which is usually the high performance vendor (designer and contractor). In the Best Value or value based environment, designers and contractors must do the following to be awarded work:

1. Compete based on proven past performance and expertise of the company and key individuals in doing very similar work.
2. Key personnel must be interviewed to identify if they can be proactive and accountable, minimize the risk that they do not control, pre-plan, and to identify if they have the expertise to manage the project.
3. Quantify the risk that they do not control (not in the scope of the project) and have a plan to manage and minimize the risk.
4. Key personnel must be interviewed to identify if they have a plan on how they will deliver the requirement which includes a solution, if they can utilize expertise and that they are effective and efficient project managers.
5. Price is determined by the professional/vendor, and it must be competitive. The most expert professional will usually be the low price proposer. The client is hiring an expert with a plan, and will financially cover all risk. The expert professional is responsible for technical mistakes, but not for risk that they do not control.

The difference between the two environments is that the price-based environment has the following negative and unstable characteristics (Kashiwagi, 2014):

1. Non-transparency.
2. Attempt to transfer risk and accountability, both of which are non-transferable.
3. Non-expert in design/construction managing and directing the expert.
4. Increased confusion, and higher flow of communication and documentation.
5. Requires more individuals to make more decisions.
6. Allows less qualified personnel to do the work due to the lack of transparency and accountability.
7. Participants become more reactive.
8. Requires increased management, direction, and control by the client's representatives who knows less.

The price based environment is setup and controlled by the owner/client. Deductive logic shows that the solution might be in changing the system from a price based system to a best value environment. The participant who can implement system change most efficiently is the owner/client because they have the control of the current delivery system (Beemer, et al. (n.d.)).

### **BV PIPS (Performance Information Procurement System)**

An example of an efficient BV system is PIPS (Performance Information Procurement System). "PIPS is an information based procurement system that uses Best Value selection and a performance contracting approach. It minimizes the liability and risk of the designer and owner, maximizes the profit of the contractor, uses partnering as a perception but not a function, and allows the expert vendor to minimize risk through a plan and transparency. PIPS has a methodology to find the best available value and motivates the vendor to assign the best experts to the project. PIPS uses dominant performance information and a transparent environment to select the Best Value contractor, and then uses the rating on the Best Value project to alter the contractor's future competitiveness and performance (Kashiwagi, 2002)." PIPS is a project management (PM) model, a risk management (RM) model, a selection process, a procurement delivery process and a Best Value structure. PIPS uses all of the Best Value practices. PIPS can be run with DBB, DB, CM@Risk, CM, IDIQ, JOC, Performance Contracting, and Best Value contracting. PIPS is a Best Value model that aligns expertise and resources; minimizes transactions; minimizes transaction time and cost; minimizes information flow, decision making, and risk. If decisions are made, the expert makes the decision, as they have the most information and can minimize risk. PIPS can be run in either the price based environment or the Best Value environment; however, it is more effective in the Best Value environment. It can be used for the delivery of any service in any industry. Information on PIPS is available at [www.pbsrg.com](http://www.pbsrg.com). ASU researchers initially developed the PIPS for construction contractor selection. It is now being used to select vendors in all industries. The system has been tested on over \$800M of construction projects with a variety of owners and \$1.5B of services outside of the construction industry. "ASU reports 98 percent on-time delivery, no change orders and an 80 percent reduction in management functions" (Angelo, 2006).

Not everyone agrees that the QBS system results in a price based system. The authors have met many designers who have voiced that the QBS is a quality oriented system which increases the value of the expertise of engineers. A survey was designed and results analysed to identify if the QBS system creates a price based environment.

### *A/E/C Industry Survey*

In October of 2009, an online (internet based) survey was prepared and invitations were sent via email to over 1,200 professionals (architects, engineers and contractors) with 449 responses received (37%). The survey was sent out using the survey hosting website [www.survkeymonkey.com](http://www.survkeymonkey.com). The survey was sent with the objective to identify issues and concepts within the price based marketplace as well as the best value marketplace. The majority of the survey recipients/participants were design professionals from the Arizona marketplace. Responses were received from professionals working for municipalities, engineering consulting firms, architectural consulting firms, contractors, utility providers, etc. The majority of the respondents came from municipalities and consulting firms, representing two distinct sides from within the design-construction market. Municipalities represent the public owner/client while the consulting firms represent the supply side of the industry. There are over 40,000 Licensed Professional Engineers, 28,000 Licensed Professional Architects, and 50,000 licensed contractors in the state of Arizona (Arizona Board of Technical Registration, 2009; Arizona Registrar of Contractors, 2009). From a statistical standpoint the A/E/C population size is considerably large. This equates to a greater than 95 percent confidence level with a plus or minus of five percent ( $\pm 5\%$ ) margin of error, using commonly accepted statistical analysis standards.

The survey consisted of some identifying questions to determine such things as the respondents' organization type, title, and whether or not they are a licensed engineer or licensed architect. The next section of the survey then asked the respondents to rate 18 statements on a scale of 1-10 (1 Strongly Disagree, 3 Disagree, 5 Don't Know, 7 Agree, 10 Strongly Agree). The first 12 statements were related to verify the existence of Quadrant I and the last six statements were related to relative understanding of Quadrant II of the Construction Industry Structure (Figure 1). The survey respondent's organization type had a nearly even split between the public and supply side of the marketplace. Private consulting services comprised 45% of the survey respondents (Engineering 28% and Architectural 17%). The public owners/clients response made up 41% of the survey. The remaining 14% of the survey respondents included contractors, developers, private utility owners and others. The results of the survey were analyzed in three distinct groups. The first group was the "All A/E/C Respondents" group, consisting of all the respondents. The second group was the "Private Consulting A/E" group or the vendor groups. The third group was the "Public Owner/Client" group or the clients who hire the vendor professionals.

### *AEC Survey Results*

The results of the survey lean heavily towards agreement with identified issues within the price based environment and with the importance of utilizing concepts of the best value environment. The overall survey results are shown in Table 1. The most frequent rating throughout the entire

survey was seven (7). It was chosen 1,457 times. The next highest was eight (8) at 1,317 times. This was followed by nine (9) and ten (10) at 1,017 and 1,011 respectively. After this, five (5) was the next most selected at 825 times. Sixty percent of the time “Agree” (7-10) was chosen, 26 percent of the time “Don’t Know” (4-6) was chosen and only 14% of the time “Disagree” (1-3) was chosen. The results of the survey show that the majority of designers either agree with the previous discussion or don’t know, with only 14% disagreeing. Rephrasing the results, if AEC participants understood the current AEC environment, the majority agreed with the concepts of IMT, KSM, industry structure and the need to change from the price based environment to the best value environment. Only 14% disagreed. Twenty-six percent didn’t know, showing the complexity of the non-transparent environment.

Table 1

**Summarized Survey Results of All Respondents**

Survey Statements	Disagree	Don't Know	Agree
1. Relationships are important to get work in QBS	8.2%	14.5%	77.3%
2. QBS system results in relationships being very important	10.5%	24.4%	65.0%
3. Design firms hired on relationships and not performance	27.7%	31.1%	41.2%
4. Major objective of A/E/Cs at a conference is to network with owners/agencies and form relationships	5.6%	18.7%	75.7%
5. Differentiation between qualified firms is difficult in QBS	26.3%	30.6%	43.1%
6. A/Es spend more money on marketing than on training, analyzing and improving their own performance	21.1%	45.6%	33.3%
7. Construction and design services are often perceived as commodities by owners	10.6%	36.0%	53.5%
8. A/Es often taken out of core expertise of adding value by design and are instead spending more and more time directing, managing and inspecting contractors	23.8%	44.8%	31.4%
9. Designers should be the experts at design and contractors should be the experts at construction	18.3%	19.0%	62.7%
10. Design services are inefficient but would be more efficient if designers were given total control of the project and held accountable	35.1%	39.1%	25.8%
11. Errors in design documents are motivation for contractor requested change orders	8.3%	20.6%	71.1%
12. Minimum requirements by owners/clients are often viewed as maximums by A/E/Cs in order to remain competitive on price, and results in a lowering of quality	14.8%	32.9%	52.3%
13. Measuring performance of design firms and key individuals would increase accountability and performance	4.9%	15.2%	79.9%
14. Designers should manage risk and deviation on project	9.0%	27.9%	63.1%
15. On design related issues, owners should rely on the expertise of the design professional to identify best course of action	7.2%	21.7%	71.1%
16. Designers should seek assistance of experienced contractors to provide accurate cost estimates and scope	2.7%	10.0%	87.3%
17. Project owners control the level of performance and quality in the A/E/C	17.5%	29.4%	53.1%



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industry since they are the ones procuring/selecting the designers

18. Qualifications, competitive price, minimization of risk, added value, and past performance of the firm and its individuals are all important factors an owner should consider when selecting/procuring a design firm	5.8%	5.4%	88.8%
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Question 5, “Differentiation between qualified firms can be difficult using QBS”, only had an average rating of 5.71 throughout the industry. However, 43% of the responses fall in the “Agree” group, 31% in the “Don’t Know” group, and 26% in the “Disagree” group. The results of this section support the notion that it is difficult to clearly differentiate one qualified firm from another in the QBS process. This result leads to identifying AEC services as a commodity and being more price based oriented. This may also explain why AEC services normally are given a percentage of construction costs, which may not have any relationship to the effort required to support the design and management of construction.

The overall response to Question 7 “Construction and design services are often perceived as commodities by owners” was interesting. The average rating was 6.51, which is right in between “Don’t Know” and “Agree”. Looking at the responses even further yields some more interesting information. Sixty five percent of the private A&E side agree with Question 7 by giving it an average rating of 7.11. However, only 40% of the public owners/clients agree and 44% don’t know, giving them an average rating of 5.8. Much like Question 3, the difference on commodity perception between private and public supports the theory that the existing QBS, price based, commodity based environment is an inefficient and confusing market where the supplier and client disagree.

Eighty percent of the industry agrees with Question 13 “Measuring the performance of the design firm and their key individuals on a project would increase their accountability and performance”. This would describe a more transparent environment. The average rating was 7.43. The majority of the industry agrees with Question 14 “Designers should manage risk and deviation on the project”. Sixty three percent of all responses fell within the “Agree” range, 28% within “Don’t Know” and only 9 percent within the “Disagree” range.

Seventy one percent of the industry “Agree” with the concepts of Question 15 “On design related issues, project owners should rely on the expertise of the design professional to identify the best course of action.” The average rating was 7.2, and only seven percent disagree. Designers also agreed that designers cannot scope and cost projects, and require the assistance of high performance contractors. Question 16, “Designers should seek the assistance of experienced contractors to provide accurate cost estimates and scope of projects”, received the second highest rating of all the questions with an 8.04 and 87% of the industry agreed with the Best Value concept.

Vendor designers agreed that owners still control the level of performance and quality of design and construction with an average rating of 6.23 and of respondents 53% rating it within the “Agree” range. These results seem to provide more support to the fact that the current design-construction industry is working in Quadrant I (price based environment). However, designers all agreed in Question 18 “Qualifications, competitive price, minimization of risk, added value, and past performance of the firm and its individuals are all important factors an owner should

consider when selecting/procuring a design firm”, was the highest rated question in the entire survey. These characteristics are attributes of an efficient Best Value delivery system. Eighty nine percent of the industry agrees with its concepts. The average rating was 8.4, and only six percent disagree.

There were only a few observable disagreements on some of the issues between the client and AEC vendor population samples. Upon analyzing the data it was determined that the major disagreement that existed between the public (client) and private sectors (vendor design firms) was in regards to the Qualification Based System (QBS). This demonstrates the confusion that exists within the existing QBS, and may be one of the major factors contributing to a price based environment. By definition, the disagreement identifies non-transparency. When transparency exists, stakeholders will agree due to the transparency and ease of understanding. The industry (vendor community) agrees that in the QBS (Qualification Based Selection) process, relationships with public owners/clients are very important in order to obtain work. This is a major characteristic of the price based marketplace, where the environment is not transparent.

The survey results showed that both the clients and the vendors were in agreement with Questions 1 “Relationships are important for design firms to get work from project owners in the existing QBS process” and Question 2 “The QBS system results in relationships being very important” regarding the QBS process, with seventy seven percent of the industry agreeing with Question 1 and sixty five percent of the industry agreeing with Question 2. The results of Questions 1 and 2 have an average rating of 7.60 and 7.01 respectively.

The disagreement between the client and vendor population came in regards to Question 3 “Design firms are often hired based on relationships instead of capability and performance.” The average rating for question three was identified to be in the “Don’t Know” range (5.58.) The disagreement between the clients and design firms can be easily seen in the histograms of Figure 18.4. Clients felt that relationships did not matter in regards to the hiring of vendors, but the design firms responses were in direct conflict. Fifty seven percent of the private A&E respondents agree with Question 3, 29% don’t know and 14% disagree. To the contrary, 45% of the public owners/clients disagree with Question 3, 32% don’t know and only 23% agree.

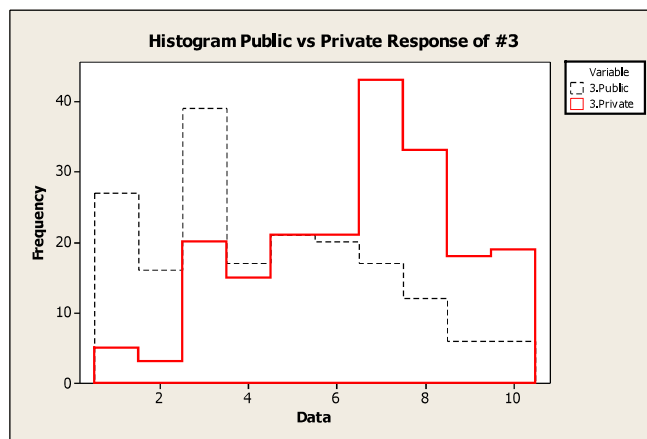


Figure 18.4: Disagreement between Clients and Vendor Designers

To verify that there was a significant difference between the public and private ratings (for Question 3) a T-test was performed, which verified that the observation was accurate, showing that the probability of making the wrong assumption was  $1.52 \times 10^{-15}$  percent. This level of error is far under the acceptable 5% at 0.01 percent (0.01%). Seventy six percent of the industry agrees with Question 4 “The major objective of contractors and design consultants at a conference is to network with owners/agencies and form relationships”. The average rating was 7.35. The results are further demonstration of the importance of relationships in the existing QBS, price based, and commodity-based market.

### **Conclusions and Recommendations**

The current AEC industry is a non-transparent, relationship based environment. The survey of designers representing both the clients/owners and the design firms validates these concepts. The current Qualification Based System (QBS) AEC selection process, is a centrepiece of this non-transparent environment. Because relationships are such an important part of the environment, the client will use management, direction and control of the AEC vendors. When MDC is utilized, AEC expertise will not be utilized. IMT, KSM, CIS and BV research has identified that when an environment is non-transparent, the value of the AEC expertise will be minimized, which leads to the commodity or price based environment. The hypothesis of moving to a best value approach where control of projects is shifted to the AEC expert vendors is validated by this study.

The AEC industry perceives that the environment is a price based marketplace. The owners/buyers of the service do not have the same understanding. The disagreement shows the confusion in the AEC industry. Survey results suggest that the A/E/C industry is strongly in favour of moving design professionals into a best value environment. The authors also suggest that the Performance Information Procurement System (PIPS) can be used as a mechanism to move the design environment.

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