Qualifications Based Selection of Construction Services:

Evaluation Criteria that Best Differentiate Contractor Qualifications

By

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A Thesis Presented in Partial Fulfillment
of the Requirements for the Degree
Master of Science

Approved November 2014 by the
Graduate Supervisory Committee:

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ARIZONA STATE UNIVERSITY

December 2014

ABSTRACT

Qualifications based selection (QBS) of construction services uses a variety of criteria to evaluate proponents and select a contractor for the project. The criteria typically fall into three categories: past performance and technical capability, key personnel, and price, with price often being considered the most important factor in selection. Evaluation and the merits of the key personnel category is not well described or discussed in research. Prior research has investigated the evaluation criteria elements and their ability to differentiate proponents. This case study uses QBS evaluation data from fifty-eight construction projects to show that use of a structured interview process provides the highest level of differentiation of qualifications of proponents, as compared to the proposed price and the technical proposal. The results of the analysis also indicate: 1) the key personnel element (the interview) is statistically more important than price, 2) Contractors who propose on projects using QBS should use their best people in proposal response, and 3) Contractors should educate/prepare their teams for interviews, people count.

DEDICATION

I dedicate this thesis to my wife, with her legions of patience molecules.

ACKNOWLEDGMENTS

I would like to express my deepest appreciation to my advisor, Dr. Kenneth Sullivan, for his years of support and thought provoking discussions. With his simple ways and words, he has helped me excel both personally and professionally. I will be ever grateful to have been able to study and learn from great educators, humorists, and leaders that did far more than serve on my committee, thank you Dr. William Badger and Dr. Avi Wiezel.

A big thank you goes to my friends and colleagues that have endured my sarcasm, my stories, and, on occasion, old Jeff. To John Savicky that helped me wrap my arms around the concept of simplicity and data crunching. To Dr. Brian Lines with whom I can laugh with and learn from in any setting. To Jake Smithwick who is always there to provide definition and education on all things twenty-first century and academic. Special thanks to my good friend Dr. William Hamilton that has helped me express myself with simple suggestions, but builds a watch every time he is asked for the time.

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CHAPTER 1

INTRODUCTION

When purchasing products, goods, or services the consideration of the cost, or price, often dominates other possible selection criteria (Eriksson, 2008). In the selection of construction services, the ultimate project quality and buyer's satisfaction correlate directly to the contractor performing the services (Kumaraswamy &Anvuur, 2008; Russell & Jaselskis, 1992). Intuitively most people understand that all companies and people are not created equal, and the price for a service may not be the key predictor of performance or project success. In 1972, the Brooks Act was passed by the US Government and paved the way for qualifications based selection (QBS) in professional services (architecture and engineering), and ultimately contracting services and other industries.

Research in the area of QBS has found that along with price, financial stability, past performance, experience, technical capability, and key personnel are important criteria in optimizing contractor selection (Del Puerto, et. al., 2008; Gransberg & Barton, 2007). These criteria for selection have been considered in various forms and weighting scenarios and, in practice, are generally classified in three categories: 1) Price, 2) Technical Capability/Past Performance, and 3) Key Personnel. The evaluation of the price and technical proposal are typically based on a variety submission documents. The Key Personnel criterion is well referenced in the literature though its merit is not widely discussed. Generally, Key Personnel refer to individual resumes, team presentations, and team interviews.

The purpose of this case study of fifty-eight projects is to determine what value an interview has to a contractor proposing on QBS projects. This study uses fifty eight construction projects that were procured using similar QBS procurement processes, including individual interviews of key personnel that would be assigned to the project.

CHAPTER 2

LITERATURE REVIEW

The selection of contractors is an important aspect in the delivery of construction projects and is linked to project success, in the terms of schedule, cost, and quality (Hatush & Skitmore, 1998). Various studies have shown that overall project quality and/or owner satisfaction is directly related to the contractor performing the work (Russell & Jaselskis, 1992; Maloney, 2002; Cheung, et. al., 2006). Hatush & Skitmore (1997) stated that, "one of the most difficult decisions taken by a client… is selecting a contractor." The majority of construction owners over-emphasize the acceptance of the lowest price (Walraven & de Vries, 2009). Hiring contractors based on price, rather than people and expertise, can be problematic. Segerstedt, et. al., (2010) noted that "Price comes first" and that subcontractor selection by general contractors are primarily price based. Holt, et. al. (1995) found that procurement methods which concentrate on price are one of the major causes of project delivery problems.

Wong et. al., (2000) looked at various contractor selection criteria to determine the importance of the ''lowest price wins" philosophy. Their study indicated that clients are moving toward broader evaluations that include more categories and that low price is not the driving category. With the Brooks Act in 1972, Qualifications Based Selection (QBS) for architectural and engineering professionals emerged and by 2001 had spread to over 41 states (Christodoulou, et. al., 2004). In construction, QBS is often used in procurement using alternative delivery processes, including construction manager at risk (CMAR) and design build, and utilize a variety of selection criteria (Gransberg & Shane,

2014; Xia, et. al., 2013). Within QBS, many studies highlight the importance of non-price criteria in optimizing contractor selection. Russell, et. al, (1992) considered "financial stability", "past performance", "experience", and "key personnel availability" as important criteria in selection. Hatush & Skitmore (1997) suggested "financial soundness", "technical ability", "management capability", and "health and safety reputation" as key criteria. Watt, et. al. (2010) found that past project performance, technical expertise and cost are the most important criteria in the choice of contractor. No matter the specific system used or studied, generally the literature indicates that past performance, technical capability, key personnel, and price should factor into the selection process.

Although key personnel are discussed as important selection criteria, little research is documented in the literature regarding the definition of how to measure key personnel and the significance of it on selection. Kadefors et. al. (2007) study found that most clients used interviews due to their "high perceived importance." They found interviews provided clarification, an opportunity for poor writers to present orally, and showed whether the people meant to work on the project participated in the bid/proposal. Furthermore, "clients seemed unsure about how to conduct and evaluate interviews and presentations in a context of public procurement." Ahmed et. al. (2012) evaluated an "oral interview," indicated that the scoring value was small, 5 percent of the total score, and provided little detail of the process or its value in selection. Published research on the use of individual interviewing and its ability to assist in contractor differentiation in QBS is very limited.

Kadefors et. al. (2007) identified that for larger more complex projects, procurement was more about attracting the best proponents and "the individual, (and not the organization) seem to become more important…" when service, collaboration, and innovation dimensions of the project are combined. West (2012) stated that, "Interviews allow the owner to judge the chemistry and dynamics of a group of people before selecting a project team" and provides a way for the evaluation team to better understand and clarify the proposal.

CHAPTER 3

RESEARCH METHODOLOGY

The objective of this study was to assess the ability of different proposal elements within qualifications based selection to create differentiation among competing construction firms. The purpose of QBS is to select firms based not only upon price, but also on their past performance, quality, and expertise. Therefore, it is critical to understand the effectiveness with which different quality-focused proposal elements are able to identify varying levels of contractor expertise during the evaluation and selection process.

With a high differentiation potential in the interview element, the study focused on the use and effectiveness of an interview process during QBS. Review of the construction literature revealed a lack of analysis of the merit of interview processes, although their usage is fairly commonplace within QBS methods.

The predominant selection methodology for construction is based on priced, also known as low bid (Walraven & de Vries, 2009). A comparison of price and interview is made as part of this study and will help define the importance of interviews to the more traditional selection element, price.

Qualifications Based Selection Overview

A qualification based selection process was used to procure fifty eight construction projects. The selection process included proponent submission of a technical proposal, a proposed price, and interviews. Evaluation of the submittals was made by the

owner organizations based upon an evaluation scoring system published within the owner's tender documents. Selection of the best qualified proponent was made based on the combined weighted scores of three evaluation criteria: technical proposal, price, and interview.

For each project, an evaluation committee of three to seven members was established to review contractor proposal submissions. The evaluation committees were comprised of individuals with various roles from within the owner organization and outside consultants. They included members from procurement, internal client group(s), leadership, owner project managers, and project design teams. All evaluation committees were trained on QBS, scoring requirements, and evaluation techniques for the specific proposal documents to be reviewed. Technical proposal evaluations were conducted independently by each committee member and price proposals were sealed from these evaluators. Thus, price could have no impact on the evaluation committee's assessment of the two qualified portions, technical proposal and interview.

The individual requirements within each technical proposal varied based on individual project parameters and the needs of the owner. The requirements typically included company technical, financial, and project capability, project risk assessments, value add proposals (contractor-proposed bid alternates), proposed schedule, and past performance documentation on key personnel and the company. Each element was scored and a combined weighted score was compiled for each proponent by the owner organization's lead procurement officer. Proponent prices were scored and weighted by the procurement lead. A combined technical proposal and price score was used to determine short listing prior to holding contractor interviews. Short-listing criteria

included number of proponents, pricing over budget (or outside of one standard deviation from the mean), and review of contractors with significantly lower overall scores as compared to competing proponents

Interviews were held with all short listed proponents. The interviews were conducted individually with key personnel identified in the technical proposal submittal. Typical interviewees included project managers and site superintendents from each short listed contractor. Each interview was limited to less than thirty minutes, was attended by the full owner evaluation committee, and was limited to questions and answers (no sales / marketing presentations).

Data Sample

For this research fifty eight construction projects from thirteen organizations were evaluated. The projects included general construction, mechanical/plumbing, electrical, and roofing. Table 1 summarizes the distribution projects by type.

Table 1

Distribution of Projects by Type

Project Type	**Quantity**	**Percent**
General Construction	31	54%
Mechanical/Plumbing	17	29%
Electrical	8	14%
Roofing	2	3%

Weighting of the selection criteria varied by project and project type. The average weighting was 45% for technical proposal. 26% for price, and 29% for the interview. The greatest variation in weighting was found in the price of general construction project types, with a weighting variant of 40% (ranging from 10% to 50%). Table 2 details percent weighting variations by project type.

Table 2

Evaluation Criteria Weighting and Variation by Project Type

Project Type	Technical Proposal			Proposed Price			Interview		
	Avg	High	Low	Avg	High	Low	Avg	High	Low
All Projects	45%	65%	30%	26%	50%	10%	29%	35%	13%
General Construction	44%	55%	30%	27%	50%	10%	29%	35%	20%
Mechanical/Plumbing	45%	55%	40%	24%	28%	20%	30%	35%	20%
Electrical	46%	54%	45%	26%	40%	20%	28%	30%	20%
Roofing	60%	65%	30%	24%	23%	23%	16%	20%	13%

The average number of proponents for the sample group was 4 with a range of 3 to 5 proponents between project types. The average project budget was $2.8M with an average selected proponent price of $2.7M, with the selection price being, on the average, 5% below budget. The total selected price for all fifty eight projects was $156.7M. Table 3 summarizes the number of proponents, selected costs and budgets by project type.

Table 3

Average Project Budget and Price Distribution

Project Type	Avg. No. of Proponents	Average Budget	Average Selected Price	% Over/Under Budget
All Projects	4	$ 2,828,306	$ 2,697,324	-5%
General Construction	4	$ 4,252,348	$ 3,946,106	-7%
Mechanical/Plumbing	3	$ 1,499,544	$ 1,630,944	9%
Electrical	3	$ 528,338	$ 492,663	-7%
Roofing	5	$ 1,250,000	$ 1,224,061	-2%

The average number of proponents selected to proceed to the interview phase was 3 with a range of 2 to 5. Not all projects short listed the proponents prior to the interview; in these projects, all proponents were invited to participate in the interview. Of the fifty eight projects, 21 (36%) had a short list determination that reduced the number proponents advancing to the interview phase. A total of 169 interviews were conducted and 7% of the time the lowest price proponent was not interviewed. A logical inference may be made from the data here that these proposals contained deficiencies in their Technical Proposals which impacted their ranking. Table 4 summarizes the number of proponents interviewed and the number of short lists made in the data set.

Table 4

Average Proponents Interviewed and Projects Short Listed Prior to Interview

Project Type	**Average No. Proponents Interviewed**	**Percent of Projects that Short Listed**
All Projects	3	36%
General Construction	3	29%
Mechanical/Plumbing	3	53%
Electrical	2	38%
Roofing	5	0%

Of the interviewed proponents, the selected vendor had the highest proposed price 16% of the time and the lowest proposed price 59% of the time. On the average, the selected vendor was 3% below the mean price and was within 6% of the lowest price. The highest ranked proponent prior to interviews was also the highest rank following the interview 74% of the time and was in the top two ranked proponents 88% of the time. A reasonable inference here would be that the interview was the critical element in the final differentiation and decision in approximately one quarter of the awards when the project price was not discriminatory.

Method of Analysis

The focus of the analysis was to determine the value and impact of interview performance on contractor selection. Data analysis was completed in four areas. First, for each project the selected contractor interview score and proposed price were categorized with all proponent interview scores and proposed prices, and further categorized by project size. Second, for each project the selected contractor interview score and technical proposal score were categorized with all proponent interview scores and technical proposal scores, and further categorized by project size. Third, the distribution of scores between the selected contractor and the second ranked were analyzed. Fourth, the effect of score weighting on price and interview scores were analyzed using a fixed weighting of the technical proposal score.

CHAPTER 4

RESULTS AND DISCUSSION

Comparing Evaluation Results for Price, Technical Proposals, and Interviews

The first area of analysis of the data compared the effectiveness of each evaluation criteria (price, technical proposal, and interview) to identify differences in quality between competing contractor proposals. This analysis was conducted by calculating the "normalize standard deviation" (coefficient of variation: defined as $\sigma/\mu * 100$, Triola (1997)) in evaluation results on a per-project basis for each evaluation criteria. For example, the standard deviation in price submissions for each project was normalized by dividing each project's standard deviation in price by that project's average price submission. Using the normalized standard deviation had two benefits. First, the standard deviation provides a mathematically quantified measure of variation from the average (such that a higher standard deviation corresponds with greater variation, and, therefore, indicates greater differentiation within the evaluation results). Second, normalizing the standard deviation of each evaluation criteria resulted in a unit-less measure of variation, where variation in price (evaluated on the basis of dollars) could be directly compared with variation in technical proposal and interview scores (evaluated on a 1-10 qualitative scale). The average normalized standard deviation for each evaluation criteria is given in Table 5 along with a breakdown by construction project type.

Table 5

Normalized Standard Deviation of Scores by Evaluation Criteria

Project Type	Price	Technical Proposal	Interview
All Projects	7%	13%	20%
General Construction	7%	12%	18%
Mechanical/Plumbing	9%	16%	20%
Electrical	8%	9%	29%
Roofing	8%	9%	29%

Results revealed the normalized standard deviation in price evaluations to be 7%, compared with 13% for technical proposals and 20% for interviews. These results show that the greatest differentiation in contractor proposals is in interview scoring, which achieved nearly twice the differentiation of technical proposal evaluations and nearly triple the differentiation seen in price submissions. To measure the statistical significance of the data sets (price, technical proposal, and interview), an analysis of variance, ANOVA, was completed with significant differences found, p=0.000, between the three. Two sample t-Tests were also completed on the three scores in Table 5; Technical vs, Interview (P=0.005), Technical Proposal vs. Price (p=0.001), and Price vs. Interview (p=0.000). The t-Tests show that for each pair, they are significantly different.

Due to the large disparity in the normalized standard deviation between the three elements, further analysis was conducted to assess the impact of interview performance on overall procurement outcomes for construction projects. In the following sections, the evaluation results recorded by the selected contractor for each project within the data set is analyzed to more clearly understand the importance of interview scores on winning the project.

Interview & Price Results for Selected Contractors

The range of element score deviation, Table 5, provided information that led to the question; is there a correlation between price and interview and what its significance is. For this analysis, four categories for the selected contractors was used and included Low Price/High Interview Score (PI), High Interview Score/Not Low Price (INP), Low Price/Not High Interview Score (PNI), and Not High Interview Score/Not Low Price (NIP). In twenty eight of the fifty eight projects, the selected contractor submitted the lowest price and had the highest interview score. In nineteen of the fifty-eight projects, the selected contractor had the highest interview score and not the low price. In six of the fifty-eight projects, the selected contractor had the lowest price and not the highest interview score with the remaining 5 selected contractors having neither the lowest price nor the highest interview score. Table 6 summarizes the price/interview categorized selected contractor distribution.

Table 6

Selected Contractor Distribution by Price/Interview Category

Price/Interview Categories	**Total**	**Percent of Selected Contractors**	**Contract Value**			
			<$1M	**$1M-$5M**	**$5M-$10M**	**>$20M**
PI (Low Price/High Interview)	28	48%	16	10	1	1
INP (High Interview/Not Low Price)	19	33%	6	10	0	2
PNI (Low Price/Not High Interview)	6	10%	3	3	0	0
NIP (Not High Interview/Not Low Price)	5	9%	3	2	0	0

In analysis of the INP grouped projects, it was determined that the selected contractor had the second lowest price 53% of the time (10 projects). Within the PNI projects the selected contractor had the second highest interview score 83% of the time (5

projects). Contract value (award price) did not appear to influence the results. In 43 projects (74%) the best proponent in either price or interview is also the best or second best in the other. Overall, in 47 of the 58 projects (81%) the selected vendor had the highest interview score and in 34 of projects (59%) they had the lowest price.

Interview and Technical Proposal Results for Selected Contractors

Further comparison on the scoring elements was made using the technical proposal and interview scores. These scores were grouped into categories: High Technical Proposal Score/High Interview Score (TI), High Interview Score/Not High Technical Proposal Score (INT), High Technical Proposal Score /Not High Interview Score (TNI), and Not High Technical Proposal Score/Not High Interview Score (NIT). In 27 of the 58 projects, the selected contractor had the highest technical proposal score and had the highest interview score. In 20 of the 58 projects, the selected contractor had the highest interview score and not the highest technical proposal score. In 7 of the 58 projects, the selected contractor had the highest technical proposal score and not the highest interview score with the remaining 4 selected contractors having neither the highest technical proposal score nor the highest interview score. Table 7 summarizes the technical proposal/interview categorized selected contractor distribution.

Table 7

Selected Contractor Distribution by Technical Proposal/Interview Category

Technical Proposal/Interview Categories	**Total**	**% of Selected Contractors**	**Contract Value**			
			<$1M	**$1M-$5M**	**$5M-$10M**	**>$20M**
IT (High Tech Prop & High Int.)	27	47%	14	11	0	1
INT (High Int & Not High Tech Prop)	20	34%	8	9	1	2
TNI (High Tech Prop & Not High Int)	7	12%	5	2	0	0
NIT (Not High Interview or Tech Prop)	4	7%	1	3	0	0

In additional analysis of the INT grouped projects, it was determined that the selected contractor had the second lowest price 75% of the time (15 projects). Within the TNI projects the selected contractor had the second highest interview score 86% of the time (6 projects). Contract value did not appear to influence the results. In 48 projects (87%) the best proponent in either technical proposal or interview is also the best or second best in the other.

Distribution of Total Evaluation Scores

The analysis indicated that in a large percentage of the projects in this sample, the top two proponents were either the best or second best in the scoring elements. To provide further analysis of the highest ranking proponents the range of the scores between the top two proponents on each project was determined and categorized by the percent deviation between to top two. In 16 of the 58 projects (28%) the total scores between the top two were found to be within 2% and in 35 of the 58 projects (60%) they were found to be within 5%. This is significant as it shows that in this QBS system the

best proponents rise to the top and the deviation in total score is small. When considering these findings and the deviation of scores within individual elements, the results suggest that price is less important than the interview element. Figure 1 summarizes the distribution of scores between the top two proponents.

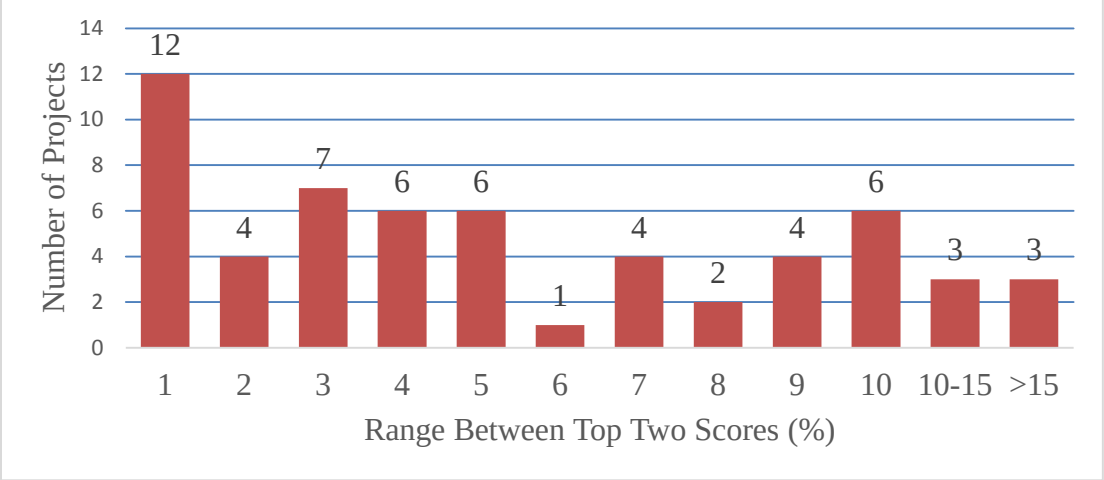

Figure 1: Range of Scores between the Top Two Proponents *n=58*

This analysis shows that more than 60% of the time the top two proponents are within 5% or less of each other in total score. This result is significant as it shows that in this QBS system the best proponents rise to the top and the deviation in total score is small. When considering these findings and the deviation of scores within individual elements, a logical and reasonable conclusion, or inference, is that price is less important than the interview element.

Potential Deviation of Results Due to Evaluation Score Weighting

The evaluation weighting criteria varied by project. To measure the potential deviation of outcomes of the selected contractor, the raw score data for each project was used to analyze the change in contractor selection with a change in weighting scenarios. The technical proposal weighting in the original data set averaged 45% with a range of 44% to 46% on all but two projects (roofing projects). Based on this, a fixed weight for the technical proposal of 45% was used with a weighting for price and interview score varying from 10% to 45% in nine weighting scenarios. Based on each weighting scenario, the number of times the selected contractor remained the highest ranked proponent or was the second highest ranked proponent was determined.

On the average, the selected contractor remained the highest ranked proponent all but 21% of the time with a range of 19% to 24%. Only 8% of the time, on the average, was the selected contractor not within the top 2 ranked proponents. Figure 2 summarizes the effect of weighting on contractor selection.

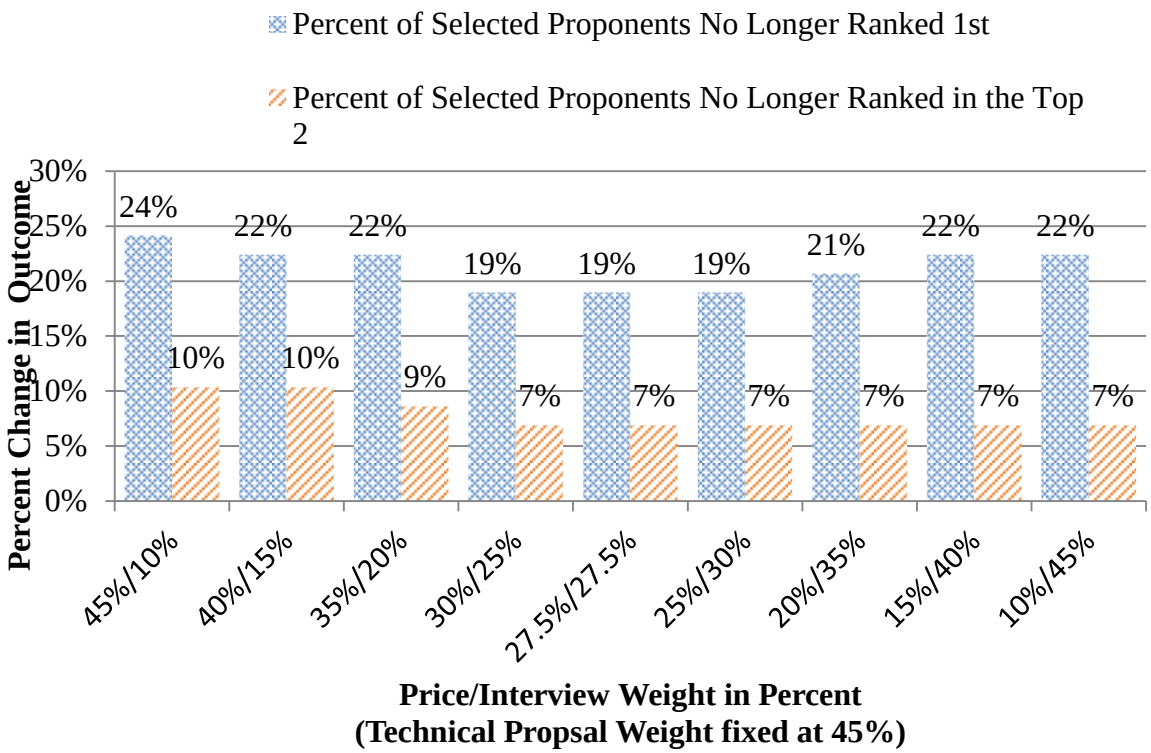

Figure 2: The Effect of Evaluation Criteria Weighting on Contractor Selection

By fixing the technical proposal weighting criteria the analysis shows that a significant number (76%-81%) of the selected contractors are selected in all weighting scenarios and that 90% to 93% of the time they are in the top two. This shows there is no significant variation in results of determining the top two proponents when evaluation score weighting is varied for the price and interview elements.

CHAPTER 5

CONCLUSION

In this case study fifty-eight construction projects were used to better understand the ability of proposal elements to differentiate proponents in a qualifications based selection process. The projects ranged in type from general construction to specialty trade projects in mechanical/plumbing, electrical, and roofing trades. Of the three QBS proposal elements, technical proposal, price, and interview, the study found that the differentiation of the proponents was low for price, at 7%, moderate for technical proposals, at 13%, and the greatest for the interview scores, at 20%. The greater the range of differentiation of proponents, the greater the value the element is for owners in selecting and justifying the selection of the best qualified proponent. For contractors proposing on QBS procured projects, the data indicate that the interview process provides them the best element in which they can differentiate themselves from their competition.

In review of the literature on QBS, it was found that presentations/interviews are commonly used and are recommended elements for selection, but little is detailed about their structure and overall value for being selected in a QBS process. This study found that 22% of the time the highest ranked proponent prior to short listing for interviews was not the highest ranked proponent in the end, suggesting that within the highest ranked group prior to interview a large number do not have the best key personnel. In 81% of the projects the selected contractor had the highest interview score and 74% of the time the best proponent in either price or interview was also the best or second best in the other.

This indicates that the top two qualified proponents are easily identifiable via price and interview. With the price component having a small range between the top two proponents, perhaps the cost of a few change orders, this study shows that key personnel are a greater factor to contractor selection than price. The QBS process used in this study eliminated the influence of price on scoring of the qualitative portions of the process by concealing the price proposals from the evaluators until the technical proposals and interviews were scored. As price did not bias the evaluation and scoring of the interviews, the accuracy of data and conclusions with regards to the importance of the interview is further substantiated

In using an interview selection process that was structured as individual interviews, with no presentation, and only with key personnel that would be assigned to the project, this case study shows that interviews play a significant role in contractor selection. Contractors can take advantage of these findings by: 1) Using their best team in proposal response, 2) Providing continuous improvement training to their people, and 3) Educating and preparing their teams for interviews. All which will enhance their ability to “win” projects.

CHAPTER 6

LIMITATIONS AND FURTHER WORK

Within this data set there were a variety of project types represented. Only 2 of 58 projects (3.5%) were within the roofing trade category. Additional projects within in roofing area would provide value in future study especially in the comparison of the value of interviews in specialty trade selection. Although the project values varied from well under $1M to over $20M, the majority of the sampled projects had a value of less than $5m and the majority of the projects were within the vertical construction sector. Study of construction projects in the horizontal construction sector and with larger project values (>$10M) would provide further findings and possible correlations. Only 36% of the projects were shortlisted prior to interviews. An increase in projects with short lists or a comparison of short listed to non-short listed proponent scores may provide additional correlations and information on this subject. The QBS process generally started with the selection of professional services in construction, architecture, engineering, etc. A case study with a similar approach is planned for a project set using QBS for selection of professional services.

Ultimately the buyers of construction services hope that their QBS approach is a predictor of performance. Future research is needed in correlating selection criteria weighting, types, and approaches to the ultimate performance of the selected contractor. Using this research methodology along with actual project performance data (cost performance, schedule, customer satisfaction) would provide further knowledge for both owners and contractors in maximizing the potential success on construction projects.

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