


SAVINGS, INNOVATION & EFFICIENCY

An Analysis of QBS
in the Procurement of
Engineering Services



The ACEC Research Institute commissioned this study to examine the benefits of Qualifications-Based Selection (QBS) in the procurement of engineering and design services. Paul S. Chinowsky, University of Colorado Boulder and Gordon Kingsley, Georgia Institute of Technology were engaged to conduct the research as an update to their initial study of QBS published in 2007.

The ACEC Research Institute's mission is to deliver knowledge and business strategies that guide and elevate the engineering industry and to be the leading source of knowledge and thought leadership for creating a more sustainable, safe, secure and technically advanced build environment.

Copyright © 2022 ACEC Research Institute. All Rights Reserved.

Table of Contents

02 EXECUTIVE SUMMARY

03 INTRODUCTION

04 Methodology

04 QBS Perspectives

04 Project Procurement Perspectives

04 Project Participant Perspectives

05 LITERATURE REVIEW

06 THE CURRENT STATE OF QBS

06 QBS Mandates

06 Current Use

07 Focus of Current Use

08 What is Being Used?

08 Summary

09 QBS PROJECT ANALYSIS

10 Procurement Method

11 PROJECT OUTCOMES

11 Project Success Perspectives

12 Cost and Schedule Performance

13 Innovation

14 Summary

16 QBS CASE STUDIES

17 CASE STUDY: Lakefront Gateway I-794 Ramps

18 CASE STUDY: St. Maries River RR Bridge & St. Joe River Bridge Replacement

19 CASE STUDY: Five Location FEMA Project in the City of Santa Clarita

20 CASE STUDY: Town Creek Culvert

21 CASE STUDY: Ripken Experience

23 CASE STUDY: Columbus State Community College School of Culinary Arts

25 CASE STUDY PERSPECTIVES

27 OVERALL CONCLUSIONS

28 REFERENCES



From direct cost and schedule benefits to indirect benefits of reduced management issues and increased innovation, QBS demonstrates a clear benefit when applied across a series of project types and geographic regions.

Executive Summary

The federal government and most states use a competitive procurement process known as “Qualifications-Based Selection” (QBS) to acquire architectural and engineering (A/E) services on public projects, where firms compete for work based on experience and technical expertise, rather than submitting the cheapest bid. After firms are evaluated and shortlisted based on their qualifications, the top-ranked firm is selected for price negotiations, and a fair and reasonable price is reached based on a detailed scope of the project. If an agreement on price cannot be reached with the most qualified firm, negotiations commence with the second most qualified firm. In most cases, the top-ranked firm is selected at a price that fits the client’s budget.

Chinowsky and Kingsley published the initial study of QBS in 2007 to examine whether and how this procurement process benefits agency clients and the public. From a quantitative perspective, their examination of project data found that using QBS saves money, achieving better performance in terms of lower construction costs and lower schedule growth compared to national averages. The study also found that the use of QBS resulted in consistently high levels of client satisfaction in terms of project success, as well as better risk management in the context of complex projects.

Today, a decade later, QBS remains the general law of the land in terms of procuring design services. Notwithstanding the benefits of QBS that were indicated by the 2007 study, as well as prior and subsequent research literature, factors including the reduction in trained staff in smaller jurisdictions, the lack of education on appropriate procurement policy, and misperceptions due to confusing marketing campaigns by alternative procurement groups, have led to questions once again arising as to the advantages of QBS. In this study, the authors address these questions through a national analysis of the state of QBS procurement, the performance of both QBS and non-QBS projects from a population of 68 projects, and a series of project case studies.

An initial objective of the current study was to determine whether the benefits of QBS in terms of cost savings and better project delivery identified previously were present today. To this objective, the overall conclusion is that QBS

continues to provide an advantage in the traditional project metrics of cost and schedule. Specifically:

- › QBS outperforms the national performance in cost growth (3 percent growth versus 6 percent growth) and in schedule growth (7 percent growth versus 10 percent growth). Based on the analysis of the projects in the study, the authors conclude that there is a strong association between the use of QBS, the quality of construction documents developed by the design team, and the final cost and schedule performance.
- › In addition to cost and schedule savings, while there are specific value-added benefits from the application of QBS procurement methods to **all** projects, it is particularly evident for **complex projects**. These are projects that can especially benefit from experienced and stable design teams comprised of high-quality providers. Complexity can emerge from numerous points in a project including community engagement, political or social sensitivities, technical challenges in design or in construction, or management and collaboration of project participants.
- › From the agency-client perspective, QBS projects achieve a greater degree of consistency in terms of project success than non-QBS projects.
- › Finally, QBS leads to increased innovation on projects. Innovation is a cornerstone of advancing project solutions and developing better solutions for clients. Innovation can occur on projects of any size or in any sector. This study found that projects incorporating QBS have a greater likelihood of producing innovative solutions. This is often based on firms having greater opportunities to explore innovations and collaborations when cost is not the driving factor in design team selection.

In summary, more than a decade after the original study, the authors once again found that QBS provides direct benefits in both the design and construction phases of projects. From direct cost and schedule benefits to indirect benefits of reduced management issues and increased innovation, QBS demonstrates a clear benefit when applied across a series of project types and geographic regions.

Introduction

Chinowsky and Kingsley published the initial study of Qualifications-Based Selection (QBS) in 2007. Today, more than a decade later, QBS remains the general law of the land in terms of procuring design services. QBS continues to provide clear advantages in terms of the quality of product produced, the reductions in cost and schedule delays due to poor documents, and the benefits of increased innovation and general satisfaction with the final project. However, notwithstanding the benefits of QBS that were indicated by the 2007 study, as well as prior and subsequent research literature, factors including the reduction in trained staff in smaller jurisdictions, the lack of education on appropriate procurement policy, and misperceptions due to confusing marketing campaigns by alternative procurement groups, have led to questions once again arising as to the applicability of QBS, the appropriateness of QBS, and the policy enforcement of QBS. This is the main difference between the context of the original study and the context for the current study. Whereas the original study emphasized an introduction to the benefits of QBS, the current study reinforces the need to educate a segment of procurement officials on procurement policy and the overall benefits of QBS for the procurement of design services. It is not a question of whether QBS is required, that is answered by state and federal law. Rather, these are questions of how the legal requirements are followed in practice and to what extent they effectively govern projects. As such, the questions surrounding QBS extend beyond project success measurements to questions of policy and governance.

In this update to the original study, we revisit questions of project performance and project metrics resulting from the use of QBS for the procurement of design services. However, we also delve into the governance issues surrounding QBS procurement. In this critical addition, the authors address the challenges facing project owner organizations as they select and implement procurement processes for increasingly complex projects. From this perspective, the study addresses the questions of why and when QBS is advantageous with a new emphasis on the complexities that projects face from political and social issues.

To answer the central research question of whether QBS' status as the preferred procurement method for design services is being challenged, a set of key objectives were established for a data-focused study to determine the

state of QBS procurement. Consistent with the original study, the **key objectives** for this study were established as follows:

- › **Provide an updated review of the research and professional literature on QBS** – Over the past 10 years, there have been new contributions to the research literature focused on QBS policies and procurement practices. An update of the literature review provides a focus on procurement research developments over the last decade.
- › **Provide a quantitative or descriptive analysis of QBS** – Much of the previous research on QBS procurement has been analyzed from a qualitative perspective, and this perspective alone is not sufficient to defend a procurement practice. Therefore, this study also provides a quantitative perspective on QBS practices.
- › **Provide a QBS case study perspective** – QBS affects both policy and procedure within a project owner organization, and its success needs to be examined to obtain data on how the process works and where the critical barriers or opportunities exist. A set of case studies provides an in-depth analysis of procurement in a cross-section of project types.

These objectives provide the context required to answer **key research questions**, including the following:

- › What is the impact of QBS on short-term and long-term project costs?
- › How does the value that QBS provides project owners compare with alternative contracting methods such as design-build or value-based procurement?
- › Does a connection exist between the use of QBS and the quality of the design output?
- › Does project type have an impact on the success of QBS?
- › What role do owner policies and processes have in QBS success? Are there interaction effects between federal, state, and local policies that are influencing QBS processes and procedures?
- › What is the relationship between risk and design costs and QBS?
- › What is the relationship between project complexity and QBS?

Introduction

These objectives will allow us to expand on the previous QBS studies that have been undertaken to date. Specifically, older studies, such as by Christodolou (2003), were limited in terms of geographic scope and project type. Although the data obtained from these studies validated the use of QBS in the limited sample frames and context of the studies, these investigations were limited in terms of the perspectives listed above. In response, the intent of the current study is to provide an analysis of QBS from multiple perspectives and success measures.

Methodology

The research methodology for this study follows that established for the 2007 study. Specifically, a multi-dimensional study was undertaken based on three perspectives that extend the analysis of QBS beyond simply a procurement process. In this expanded perspective, a policy-process-procedure (PPP) set of perspectives were adopted as follows:

- › **Policy** – QBS is a procurement policy that is followed by public agencies. The first perspective to analyze the effectiveness of QBS is whether QBS is meeting the requirements of the Brooks Act, as well as the policy goals of agencies, including life-cycle costs, meeting quality expectations, and meeting societal needs.
- › **Process** – QBS is a process that is followed by procurement officers and business development managers. From this perspective, QBS must be analyzed to determine the impact of problem definition, administrative oversight, and consistency on design costs, project risk factors, and life-cycle effectiveness.
- › **Procedure** – QBS is a procedure that is followed by individual firms to submit proposals and qualifications to public agencies and procurement officers. From this perspective, QBS must be analyzed in terms of pragmatic benefits, including design fee leverage, fee vs. total project costs, fee vs. life-cycle costs, and fee vs. project risk factors.

This triad of perspectives provides a broader picture of the QBS procurement process and the interrelationships between the contracting agency and the design firms.

QBS Perspectives

The first component of implementation for the multi-perspective approach required input from consulting engineering association state directors to obtain insights into the way QBS procurement was being implemented within their states. A survey tool was deployed to each state to obtain these perspectives. The survey, as detailed in the following chapters, emphasized policy and governance in response to the first leg of the triad, policy. The responses from each state were compiled to provide a foundation to reveal how, where, and when QBS is being used on a national basis.

Project Procurement Perspectives

The second component within the overall study was obtaining perspectives of QBS at a project level. For this focus, a survey tool was deployed to a cross-section of project participants based on project nominations submitted by engineering firms. Projects crossing sectoral boundaries, geographic boundaries, as well as differences in size and scope were included in the final population from the overall set of project nominations. As detailed later in the study, each project was queried for success metrics, scope characteristics, and participant perspectives. The compilation of this data provided input to the questions of QBS process and procedure.

Project Participant Perspectives

The final component of the effort focused on obtaining deeper perspectives into a cross-section of projects through case studies. The case studies entailed interviews with project participants encompassing questions relating to all three elements of the study triad. The intent being to extract the underlying reasons behind the answers that were provided in the project nomination form. Each participant was provided with the opportunity to go into depth on any of the topics and thus provide a greater understanding of why and how the project was approached and completed.

The combination of these methodological steps and devices provided the comprehensive perspective required to generate the list of conclusions provided at the end of this report. The following chapters introduce each of these steps as well as the data collected and interpreted in each stage.

Literature Review

Qualifications-Based Selection has been the preferred method for procuring professional design services for more than 50 years and has been endorsed by numerous organizations such as the American Public Works Association and American Bar Association. However, advocates for alternative procurement methods, primarily Best-Value (BV) procurement, are increasing advocacy efforts to both reintroduce price to the procurement process as well as open the door further to greater influence by construction organizations over project delivery. One of the primary factors leading to this trend towards cost-including procurement methods is the perception that greater consultant qualifications are inherently associated with higher design and construction costs.

However, the perception that QBS procurement's focus on qualifications results in higher design fee costs has been shown to be incorrect. In fact, greater qualifications do not, in fact, correspond with higher design fees. In one analysis of 42 projects, no significant correlation was found between more qualified firms and higher cost proposals (Shalwani 2017). A separate study by the same researcher supports this same conclusion, as 122 publicly procured A/E projects analyzed across North America revealed that greater consultation qualifications had no correlation with higher design fee costs (Lines and Shalwani 2019). Contrary to an oft-quoted Molenaar study (1999), a more recent study found that QBS performed better in terms of cost when compared to best value procurement in 160 Design-Build DB projects built between 2008-2019 (Adamtey 2020). These studies all showcase the inaccuracy of the assumption that qualifications and past performance-based procurement necessitate higher design fee costs.

Much of the cost efficiency created by QBS is due to the strength of design documents obtained through this procurement method. Past performance and proficiency have been found to lead to higher quality design documents and lower construction costs (Gransberg et al. 2020). In contrast, poor design documents lead to increased construction costs incurred through construction contract modifications and errors. Though design fees themselves can range from 4 percent to 15 percent of the total project cost, their impact on the rest of the project is significant. Studies have determined that 56 percent of construction contract modifications were due to design deficiencies, and design errors and omissions discovered during construction accounted for 79 percent of all contract modification costs, which in turn averaged 9.5 percent of total project cost (Burati et al. 1992). An Australian study in 2011 reinforces this connection between cost growth and poor design documents, as it found that poor design documentation was the major source of rework, leading to construction cost increases (Love 2002).

Continuing with the focus on cost and project results, in a review of 76 design-build projects in the US, QBS was found to have the lowest cost growth and the fastest construction speed when compared to sole source, best value, and low bid (Wardani et al. 2006). A study focusing on US airport public works contracts found that the use of QBS procurement increases the quality of the tender's design documents, which in turn, increases construction certainty (Gransberg et al. 2019). Additionally, investing more design effort was shown to reduce the project's final cost from early estimates by solving construction problems during the design phase when the costs are lower than after construction has commenced. Another metric from which to judge design documents is the volume of Requests for Information (RFI) generated by the documents. Well over three times as many owners (50 percent) cited better performance from their QBS teams related to RFI's than owners preferring fee-based approaches (Dodge 2020).

This focus in the literature on the relative benefits of QBS procurement versus design-build and other procurement options highlights the need for a revisiting of the benefits of QBS. In this study, the authors focus on the question of the value of QBS in the overall project context. In contrast to the move towards including price in all project decisions, the current research takes a critical look at the overall benefits of QBS to the project and the owner.

These studies all showcase the inaccuracy of the assumption that qualifications and past performance-based procurement necessitate higher design fee costs.

The Current State of QBS

To better understand the current use of QBS across the 50 states, we surveyed engineering association state directors who monitor and work with state and local procurement rules and work with the professionals impacted by the implementation of these rules daily. This overview was obtained through a 17-question survey sent to each state director addressing current QBS use in their states in several dimensions, including 1) current regulatory guidelines, 2) QBS enforcement, 3) QBS support, 4) QBS usage, and 5) alternative procurement usage. The research team received replies from all 49 states where the American Council of Engineering Companies (ACEC) has a formal state director¹. The following sections summarize these responses in terms of the major areas covered.

QBS Mandates

Overall, the commitment of state governments to QBS contracting continues to be strong. QBS contracting processes are embedded in state laws throughout the US. In 10 states, the law is further supplemented with state agency regulations or an executive order. In over half of the responding states, QBS mandates apply to all state and local entities; and in an additional 11 states, the mandate applies to all state agencies. Only two state directors report a lack of any state mandate for QBS contracting processes (Indiana and Vermont).

It is also clear that states take compliance with QBS seriously, with directors noting compliance regulations for procurement practices. However, a segment of directors also notes that an area needing additional regulatory attention is the need for sanctions that can be applied to governments and agencies that fail to adhere to QBS practices. We previously identified this pattern of established QBS laws and mandates and the need for greater oversight and enforcement in our first study over a decade ago. In this survey, we dug deeper to explore current patterns of use of QBS contracting in the states.

Current Use

The focus on how QBS is being used today after a decade since the last study led to a focused set of questions around current QBS procurement patterns. As stated previously, QBS remains the law in the majority of states and, as such, usage remains very high across the country. While enforcement remains an issue, the intent to use QBS remains strong. With this continued commitment, we looked further then into the questions of whether there were any roadblocks in place that were preventing any jurisdictions from fully implementing QBS.

To get at this issue, the state directors were queried as to the current use of QBS at various levels in the state and local government structure. Specifically, the use of QBS at the state, county, municipal, and school district levels was analyzed.

TABLE 1 Use of QBS at State and Local Levels

	All State Agencies	Agency Most Committed to QBS	County	Municipal	School Districts	Other
Group Average	4.5	4.9	3.3	3.2	3.1	3.0
Number of States with 81-100% Use	34	42	13	11	13	11
Number of States with 40% or Less in Use	2	0	12	16	18	18
Survey Options: 1:0-20%, 2:21-40%, 3:41-60%, 4:61-80%, 5: 81-100%						

¹Alaska does not have a full-time ACEC state director

The Current State of QBS

As illustrated in Table 1, QBS continues to be the primary procurement tool at the state level and throughout state-wide agencies. The highest rate is in the state agency that is most committed to QBS, with almost all states saying that within this agency, QBS is used over 80 percent of the time. Similarly, across all state agencies, the majority of state directors are saying that all state agencies are using QBS at least 80 percent of the time.

However, there is concern that the use of QBS drops off when the focus of procurement moves to the local levels. As illustrated, counties, municipalities, school districts, and other agencies are found to be using QBS closer to the 41-60 percent range. While this remains strong, it illustrates a gap that needs to be bridged. This finding led to the question of whether this is a performance issue, which goes against the quantitative analysis of this and other reports, or is it an education issue among procurement officials.

The answer to this question was found in further analysis of the case studies as well as outside procurement literature. Specifically, the move away from QBS in some local jurisdictions can be placed in two areas: education and capacity.

In terms of education, turnover in procurement departments has been increasing over the last decade, with long-term civil servants retiring and procurement turning over to less experienced individuals in several areas. Concurrent with this turnover has been a significant increase in the level of advocacy from alternative procurement groups. In this combination, the level of knowledge concerning the core benefits of utilizing QBS has dropped amongst some local jurisdictions. Hence, this is not a performance issue, but in many cases, a perception issue that QBS is costlier, which is being put forth by alternative advocacy groups.

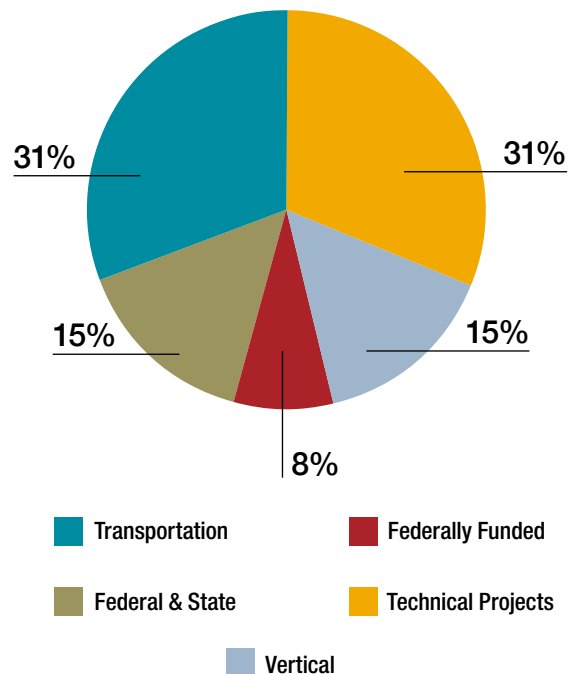
In terms of capacity, there are many smaller jurisdictions where procurement responsibilities do not fall to a dedicated staff. Rather, procurement is part of a larger set of responsibilities that a single individual may have. In these cases, individuals have reported that they believe QBS may take longer up front, and this presents a capacity issue. These individuals are less concerned about the downstream risks involved with alternative procurement methods than they are with the time spent on

procurement, as their responsibility is limited to procuring design services and getting a project moving so they can return to other responsibilities.

Focus of Current Use

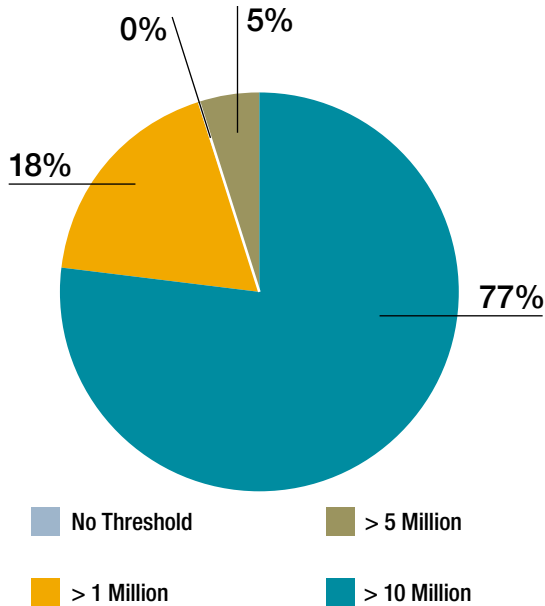
In response to the type of projects that are most often using QBS in their jurisdiction, the primary driver for QBS continues to be federally funded projects and in particular, transportation projects (Figure 1). In terms of the overall value of the project, Figure 2 illustrates that the value of the project is a far less significant factor in terms of QBS usage than the type of project. Fully 77 percent of respondents indicated that there was not a dollar value threshold level above which QBS is required to be used as the procurement method. Only 23 percent indicated that projects had to have a value of at least \$1 million for QBS to be required. This provides a strong indicator that the type of project, and more specifically, what entity is funding the project, is the primary driver of the use of QBS procurement.

Figure 1: The drivers for QBS use.



The Current State of QBS

Figure 2: Threshold value of projects for using QBS



What is Being Used?

With QBS continuing to be the law in the majority of states, the last question for the state directors was to indicate what other procurement methods are currently being used and how design services are being procured in those systems. The responses provide an indication of the broad range of procurement methods that are being tested, primarily in local jurisdictions. As indicated in Table 2, Best-Value and Design-Build procurement methods are being increasingly tested. Within the states using BV or DB for the selection of design professionals, a variety of methods are employed, including weighting and scoring of various types, many of which include price.

The implication of these responses is that design services are often being combined in Best-Value and Design-Build procurement strategies where these services are only one component of a broader point or weighting system. These alternative procurement systems are a controversial stepping-off point for including price in design firm procurement which goes against the basic regulatory restrictions evident in these same locations.

TABLE 2 Types of Procurement Systems Being Utilized Within the States

Procurement Type	Number of State Respondents
Low Bid	30
Best-Value	28
Low-Bid Design-Build	20
Best-Value Design-Build	29
Quality and Cost-Based Selection	19
QBS with salary caps	7
QBS with mandated restrictions	6
Two Envelope system	21

Summary

QBS continues to be mandated in some form in all but four states and is uniformly applied in the majority of state-level projects, such as federally funded transportation projects. In some smaller jurisdictions, the QBS landscape is less clear with the entry of alternative procurement options due to challenges, including education and capacity. These findings echo the general trends reported in the literature review of QBS use being challenged by procurement agents at the local level (in favor of price-based methods) and under increasing competition from price-based procurement methods. Use of cost as a factor can appear to be the correct approach to a procurement official who is primarily focused on the contracted design cost rather than the potential downstream costs and schedule impacts over the course of the project. The combination of this drive to include price, lack of equal enforcement, and the need for education at local levels creates a current use environment that can best be summarized as QBS remains the mandated procurement method, but additional education is needed in some areas to ensure appropriate use.

QBS Project Analysis

The second part of this study moved from analyzing the overall state of QBS procurement to a focus on the outcomes resulting from the use of QBS. In this phase, projects from multiple sectors, procurement types, levels of success, and geographic locations were solicited from engineering firms to provide a population from which the impact of QBS on project delivery could be analyzed. The focus of this effort was to create a foundation of data on which overall conclusions could be developed around the impact of QBS on project delivery. In this section, the projects were analyzed on a national basis in four areas: procurement, outcomes, management, and innovation.

The project population from which the results are presented was derived from a call for project nominations from the ACEC membership. Like the initial phase, a Qualtrics survey was employed to obtain input from participants on specific projects. The participants' self-nominated projects to be included in the final population. The initial call for nominations resulted in 147 potential projects being put forth. From this initial group, nominations were reduced by factors such as incomplete nominations, requests for confidentiality of data, and inability to contact project participants. At the conclusion of this process, 68 projects were included in the final population. An additional request went out to these projects to provide further budget and schedule information to enable the cost and schedule growth analysis to be conducted.

Here we explore the nature and distribution of these nominations. This will assist us in understanding potential sources of bias in the analysis. Bias can occur when certain classes of cases are over-represented in the sample studied. One of the challenges associated with this study, as well any similar study, stems from the absence of an established data source that is representative of the population of projects nation-wide. This is a gap at the federal level that needs to be addressed. To compensate, we compile characteristics of these projects as follows.

The geographic location of the projects:

1. The states with the largest number of nominations are Hawaii (9 cases), North Carolina (6 cases), and Texas (10 cases). This represents 37 percent of the cases nominated.
2. Cases were nominated from companies located in 26 states. Regional distribution of these states and the respective case nominations is found in Table 3.

TABLE 3 Case Nominations by Region and State

Region	States in Region	Case Nominations	Regional Summary
NORTHEAST	Maryland	1	11% of States in Sample 7% of Case Nominations
	Pennsylvania	1	
	Rhode Island	3	
SOUTHEAST	Alabama	2	27% of States in Sample 27% of Case Nominations
	Florida	2	
	Georgia	4	
	North Carolina	6	
	South Carolina	2	
	Tennessee	3	
MIDWEST	Indiana	1	19% of States in Sample 15% of Case Nominations
	Kansas	1	
	Michigan	3	
	Ohio	4	
	Wisconsin	1	
SOUTHWEST	Arizona	1	15% of States in Sample 19% of Case Nominations
	New Mexico	1	
	Oklahoma	1	
	Texas	10	
MOUNTAIN WEST	Idaho	3	15% of States in Sample 10% of Case Nominations
	Montana	1	
	Nevada	2	
	Utah	1	
PACIFIC	California	3	11% of States in Sample 19% of Case Nominations
	Hawaii	9	
	Oregon	1	

QBS Project Analysis

Case nominations reflect the variety of project types pursued by engineering firms. Figure 3 provides a breakdown of the types of projects nominated. Case nominations are primarily for projects with public sector owners (96 percent). In addition, 53 percent of the projects nominated are for renovation, repair, rehabilitation, or alteration, while 47 percent of the projects are for new construction.

Figure 3: A breakdown of the project types in the database for the current study.

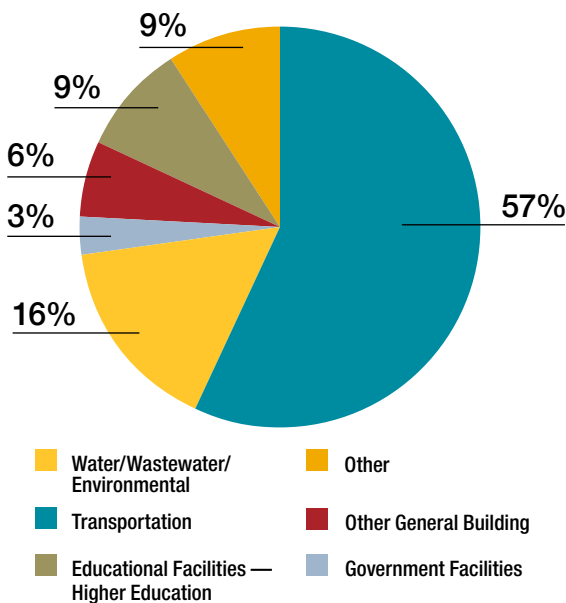
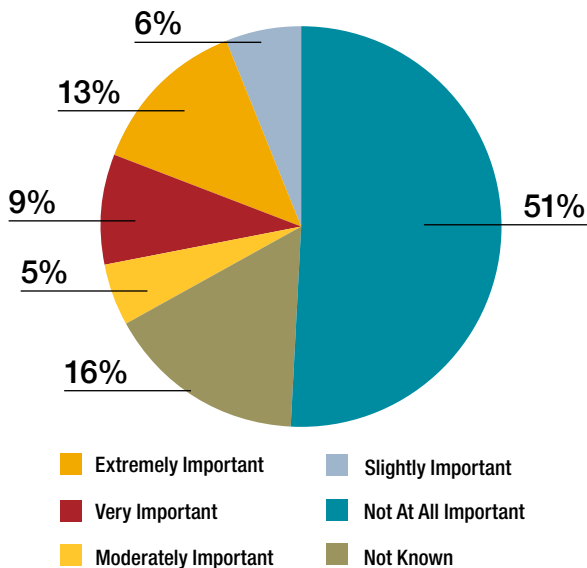


Figure 4: The selection of a procurement method correlates with an understanding that QBS benefits projects, both short-term and long-term.



Procurement Method

Among the cases nominated, 78 percent employed a QBS method for procuring design work. The remaining cases were evenly divided between best-value, sole-source, low bid, and other procurement processes. Among the case nominations, 51 percent of the cases involve county and city governments as the project owners, with 83 percent employing a QBS procurement method.

As a foundational question to the study, an initial query to nominators was to determine whether price was a driving factor in the procurement process. As such, we asked those nominating cases to indicate the role of price in the final selection of the design firm. For the overall population, there was not a focus on price as the deciding factor for selecting firms; this staying within the core focus of a QBS process (Figure 4). Respondents rated the role of price on a 5-point scale (5 indicating price as an extremely important factor and 1 indicating price as not a factor). The average response across all case nominations is 1.5. However, in the population of projects that did not utilize QBS, 70 percent of the respondents indicated that price was either “Very Important” or “Extremely Important.” This response reinforced the conclusion that there is a misperception in some jurisdictions that utilizing QBS results in higher project costs.

The difference in responses to the role of price in design firm selection indicates a strong link between the procurement method selected and the misperception that incorporating QBS results in higher costs.

Project Outcomes

A primary determinant of the success of any procurement methodology is the outcomes that are generated when utilizing that methodology. In this study, project outcomes were analyzed from several perspectives, including opinions on project success, the degree to which projects met project schedules and budgets, and the level of innovation that was brought to the project. The following sections introduce these multiple perspectives on project outcomes to build a relationship between project procurement methods and project outcomes.

Project Success Perspectives

The first perspective analyzed from the survey data was the level of project success as viewed from the designer's perspective. When looking at all projects in the population, 88 percent of the projects received a rating of "High" or "Very High" from the respondents. This indicates that a large majority of design firms believed their projects were an overall success in terms of meeting project objectives. However, when looking at the non-QBS projects, a notable difference between the two populations emerges in the comments associated with the projects. Specifically, comments in the QBS-based projects emphasize the value of previous experience as well as the relationships between the project stakeholders. Examples include:

- › "Experience in this type of project was critical"
- › "Strong relationships with client and local agencies"
- › "[Designer] has worked on a number of [owner] projects and have developed a great respect for the process"

These quotes reflect the importance of experience and established professional relationships in developing successful project solutions. The design firms frequently commented on the teams they had developed and collaborated closely with over time in addressing unique issues on complex projects.

The second perspective on project success emerged from the owner's point of view. The results from this question mirrored the overall results from the designers, with 89 percent of the projects receiving "High" or "Very High" satisfaction. When looking at non-QBS projects, a similar drop is seen in the results to 75 percent satisfaction as was documented for the design firms (Figure 5). In contrast to the designer perspectives, the owner perspectives focused more on understanding the project process and the ability to collaborate with the design firms on future funding requests. Representative comments, both positive and negative, are as follows:

- › From a non-QBS project: "A better understanding of the design-build process could have benefited this project"
- › From a QBS project: "We were successful in assisting with federal, state, and local funding"
- › From a QBS project: "Successful performance on the project allowed client to receive additional funding which was added to the scope of services"

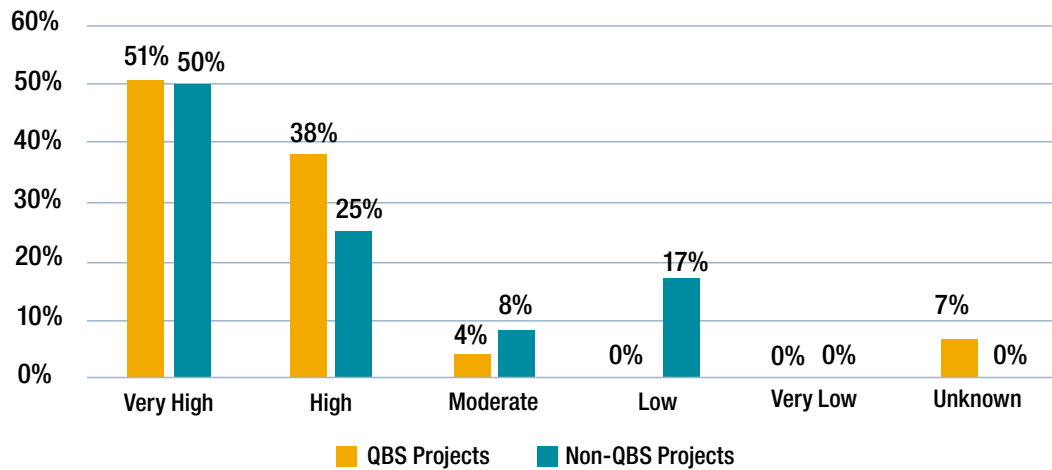
In contrast to the designer comments, the owner comments emphasized the value owners placed on their ability to further their objectives in terms of county or city development. These comments emphasized the positive opportunity on QBS projects to collaborate with an experienced design team to build on the design team's experience to better position their proposals for future funding.

In this study, project outcomes were analyzed from several perspectives, including opinions on project success, the degree to which projects met project schedules and budgets, and the level of innovation that was brought to the project.

Project Outcomes

Figure 5: Project success from the owner perspective was influenced by the procurement method in half of the project population with a significant increase in low scores on non-QBS projects.

Level of Project Success from an Owner Perspective



Cost and Schedule Performance

The core metrics of project success are schedule and budget. While these metrics may not encompass the complete impact of a given project, they traditionally are held as key indicators of how well a project was managed during development and how well it met the short-term goals of the owners. In the previous QBS study, the fact that QBS-based projects were consistently lower when compared to national norms in terms of cost and schedule growth was a key highlight of the analysis. In the current study, the team went beyond surface cost and schedule metrics to focus on the impact that design can have on the constructability of a project, which ultimately influences the overall cost and schedule. Thus, the study looked at the traditional overall project cost and schedule, but also specifically the growth in the construction project as it reflected the quality of the construction documents.

The overall perspective in this category is the impact of QBS on cost and schedule growth. Utilizing updated literature reviews of cost and schedule growth, the project established a national norm of 10 percent growth for schedule and 6 percent growth for budget (Tran et al. 2018). While this metric varies between studies, it remains

consistent with the metrics used in the previous QBS study. Utilizing this metric as a comparison, the current effort found that QBS projects outperform the national average in both cost and schedule growth. In terms of cost growth, the QBS projects analyzed in this study had an overall project cost growth of 3 percent. This is half of the national average of 6 percent. When isolating this to just construction cost growth, this increase remains low at only 4 percent. Based on the in-depth case studies, this reflects the quality of the construction documents developed by the design firms, which is a primary benefit of this process to potential owners. In terms of schedule growth, QBS projects outperformed the national average by having a schedule growth of 7 percent versus the national metric of 10 percent. This is a 30 percent reduction in the typical schedule growth of a project.

The first metric designed to address the underlying reasons why QBS outperforms the national average focused on the issue of design schedule milestones. In this query, the research distinguished between meeting all milestones, meeting most milestones, and meeting about half of the milestones or less. In terms of design milestones, 66 percent of projects met all milestones. In this perspective, there was no significant difference between QBS-based projects and non-QBS projects.

Project Outcomes

However, it is in the second metric, a focus on construction schedule milestones, that the difference between QBS and non-QBS projects is detected. Specifically, 48 percent, or about half of the QBS projects met all construction milestones with no adjustment in schedule required. Conversely, only 32 percent of non-QBS projects had the same performance. This is a 50 percent increase in the number of projects that met all schedules. From this result, the experience brought forward in QBS has an impact on the construction process.

The significant differences between these populations are highly correlated based on interviews with project participants and analysis of the projects with the quality of the construction documents put forward by the design team. And following on that point, the teams with the greater experience working together, and in that sector, consistently produced documents that resulted in fewer delays during the construction process caused by incomplete documents or documents requiring clarifications.

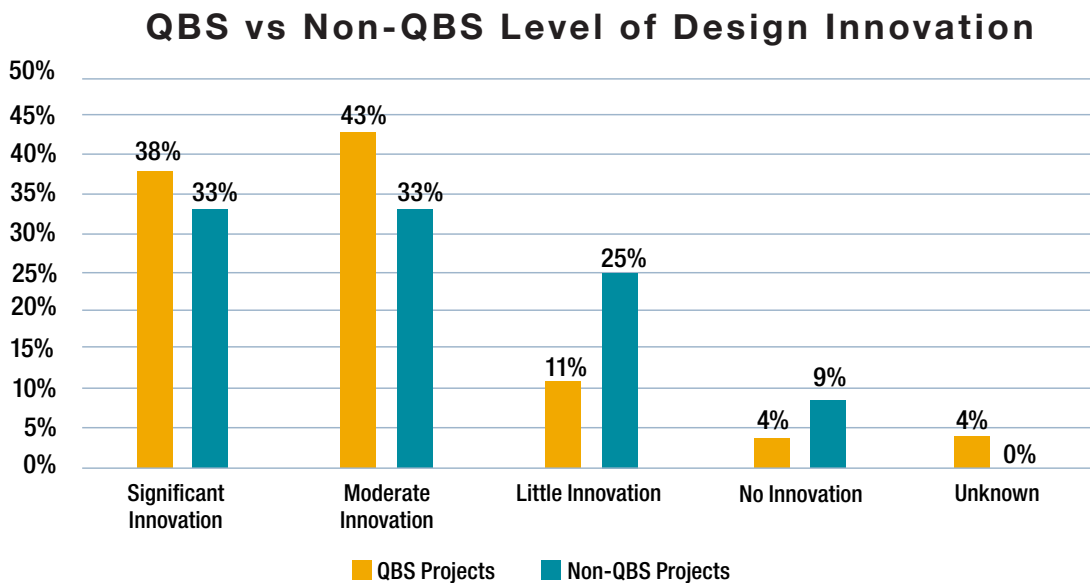
Innovation

The final outcome-based metric explored in the study focused on the level of innovation employed on each

project. The innovation metric is included for two reasons. First, innovation is an indirect measure of project complexity as more complex projects often require more innovative solutions to address those specific project challenges. Second, innovation is a measure of how design firms approach a project in terms of the flexibility of solutions they may bring to the project. This is an important factor as the greater the number of tools and solutions that a team can bring to a project, the greater the likelihood that they can provide a solution that meets or exceeds client expectations.

From this perspective, there is a notable difference in the rate of innovation noted by the participants (Figure 6). On the upper end of innovation, QBS projects were 23 percent more likely to have moderate or significant innovation included in the solutions. However, of greater significance is the fact that non-QBS projects were 79 percent more likely to have little or no innovation included in the project. This is a significant finding as it notably reduces the opportunity for an owner to have a project delivered that considers new or emerging solutions to issues that arise on the project. Additionally, it significantly reduces the likelihood that cost or schedule-saving opportunities might be explored by the design team.

Figure 6: QBS projects were 23 percent more likely to have significant or moderate innovation while non-QBS projects were 79 percent more likely to have little or no innovation.



Project Outcomes

As a second element to innovation, the team analyzed the comments for the projects in terms of the complexity of the project and the introduction of innovative solutions. From this perspective, the team found that projects that mentioned complexity either in terms of physical challenges or in terms of social or political challenges were consistently higher in terms of innovations when QBS was the procurement method used. As discussed in the case studies, this relationship was consistently reinforced through interviews. Specifically, it was found that while QBS continues to be a benefit on all types of projects, this benefit increases with the complexity of the project.

Summary

In summary, the analysis of the projects in the study population provided a foundation for establishing key findings as well as the lines of inquiry for the in-depth case studies in phase 3 of the study. The overall distribution of the projects provided a national perspective on the use of QBS in project procurement and the resulting project outcomes. The key messages from the analysis include the following:

- › QBS projects outperform the national average in cost growth (3 percent vs. 6 percent).
- › QBS projects outperform the national average in schedule growth (7 percent vs. 10 percent).
- › QBS has a strong positive impact on every project.
- › There is a strong link between the level of complexity, the project outcomes, and the use of QBS as the procurement method. As the complexity of the project grows, the positive impact of using QBS grows along with it.
- › Project success metrics are positively influenced using QBS as a result of the experience level of the teams that are brought to the project and the likelihood of generating documents and solutions that reduce costs and schedules during construction.
- › Project success from an owner's perspective is influenced by the experience of the design team and their ability to meet project milestones.





QBS Case Studies

The third phase of the QBS study focused on obtaining deeper insights into the use and non-use of QBS by analyzing actual project scenarios. Undertaking this analysis entailed direct interviews with project participants from representative projects — representative being the key element of the study. To maintain objectivity in the study, six projects that provided a cross-section of the population under consideration were chosen for further analysis. This cross-section included projects from multiple sectors (transportation, infrastructure, buildings), geographic dispersion, multiple sizes in terms of design fees, new construction, and renovations, and finally, both QBS and non-QBS projects.

The analysis of the case study projects started with an interview of a key project participant who was identified in the project nomination phase. Each interview consisted of a 30-minute session where key issues were discussed as follows:

- › The perceived complexity of the project
- › The social and/or political issues associated with the project
- › The success metrics of the project
- › The perceived role that procurement played in the success metrics
- › The firm's perspectives on procurement

The justification for these lines of inquiry is that these key project participants are in the best position to provide perspectives on the various factors that influenced the project's ultimate level of success. The interviews were therefore focused on understanding the role that these multiple factors played in the final project outcomes. It is from these perspectives that the series of observations and conclusions presented at the end of this chapter were developed.

To maintain objectivity in the study, six projects that provided a cross-section of the population under consideration were chosen for further analysis. This cross-section included projects from multiple sectors (transportation, infrastructure, buildings), geographic dispersion, multiple sizes in terms of design fees, new construction, and renovations, and finally, both QBS and non-QBS projects.

Lakefront Gateway I-794 Ramps

This joint project by the City of Milwaukee and Wisconsin DOT followed the QBS process to construct the Lakefront Gateway I-794 Ramps at Lincoln Memorial Drive. This project required a significant amount of public outreach and involvement between the city, state, county, and numerous other stakeholders. Out of a community advisory committee created for this project emerged a Streetscape Subcommittee tasked with collaborating on elements such as terrace pavers sign structure aesthetics. This significant amount of community engagement on this project greatly added to the project's complexity. According to a designer on the project, "Projects with community involvement, social components, and additional community features require design firms with broader knowledge and understanding. This brings QBS into a positive position." Less qualified and experienced firms might have a harder time balancing these complicated social factors, showcasing the benefits of using QBS procurement to select more qualified, experienced, and ultimately successful design firms.

Reinforcing many of the well-established notions in the literary review regarding complexity, the project designers found that QBS was a necessary component to the success of the project due to the project's complexity. From working with the public and balancing multiple agencies, there was a need for a firm that could manage all of the moving parts effectively. In this project, concerns about the possible mismanagement of the design and public outreach far outweighed price-based concerns.

Projects with community involvement, social components, and additional community features require design firms with broader knowledge and understanding. This brings QBS into a positive position.



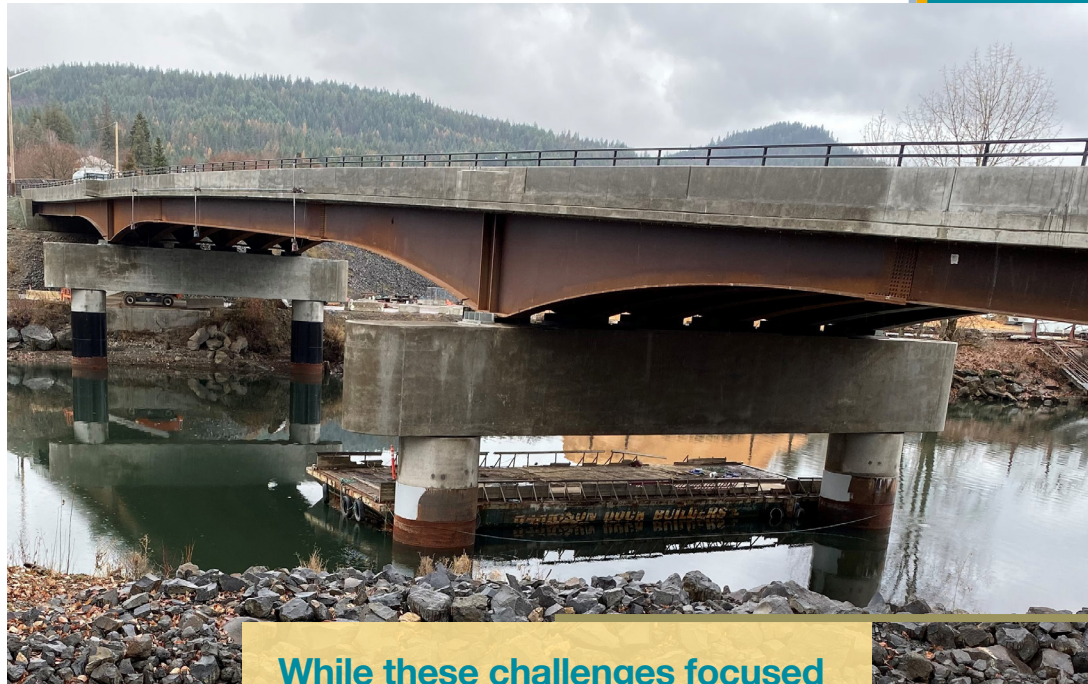
St. Maries River RR Bridge & St. Joe River Bridge Replacement

Utilizing Best-Value Procurement, the St. Maries River RR Bridge & St. Joe River Bridge Replacement was selected as a case study as it presents an enlightening look into the positives and negatives of alternative delivery systems, specifically Best-Value Procurement. The project presented challenges including a requirement to maintain traffic on a major Idaho logging thoroughfare as well as a requirement to drill 130' piers into the water adjacent to the existing bridge. Innovative methods in bridge construction, temporary traffic control, public involvement, and environmental permitting were all used to meet these challenges during design and construction.

Juggling traffic control, public involvement, environmental permitting, and the engineering work itself, the project was technically difficult. This created the context for both the positives and the negatives that emerged on this project. In terms of positives, the design-construction collaboration enabled the team to identify constructability issues early in the design process. This identification reduced further delays as the schedule might have been stretched further if the design issues were not known prior to the bid. The team believes that the flexibility of the design-build process allowed for quicker responses to unexpected delays than a traditional design-bid-build project. Additionally, the close collaboration between the contractor and the design team enabled the project to navigate a number of challenging construction tasks related to building a new bridge while maintaining existing traffic flows.

While the design-construction collaboration was a positive experience, the lack of experience in using alternative delivery methods contributed to schedules not being met in several instances. Specifically, the roles and responsibilities of each

player were not explicitly spelled out prior to the beginning of the project. Additional review responsibilities were placed on the design team during the project. While these challenges focused mainly on the management side rather than the project implementation phase, they highlighted the importance of having a team that had experience to understand the individual roles and responsibilities during a complex project build. Although this project turned out to be successful on completion, it serves as a potential warning that a strong design team is required to successfully collaborate with a construction firm during such a complex project.



While these challenges focused mainly on the management side rather than the project implementation phase, they highlighted the importance of having a team that had experience to understand the individual roles and responsibilities during a complex project build.

Five Location FEMA Project in the City of Santa Clarita



According to the design firm, the QBS process, along with a review of the fees, provided a well-rounded combination of quality, service, and value to taxpayers.

While research strongly suggests that QBS provides major benefits to complex projects, in particular, it is similarly important to note that QBS has been found

to have the same merits in less complex projects as well. One such project is the Five Location FEMA Project in the City of Santa Clarita. Acquired through QBS in a Design-Bid-Build process, this project provided flood protection and safety improvement for areas of the jurisdiction that were substandard. Before the actual designing, a cost-benefit analysis was done to select the best locations and design for public value. The design firm worked on the preliminary phases of the project and later competed for the final design phase. Upon selection based on qualifications, some comparisons were made to other firms in terms of the potential hours and budgets, and an agreeable fee was negotiated. According to the design firm, the QBS process, along with a review

of the fees, provided a well-rounded combination of quality, service, and value to taxpayers.

Looking at the project's complexity, it was rated a 3 out of 5 by the design firm as it had some complexities but was not thought to be especially challenging. Similarly, the design project was noted as having moderate innovation. In this case, the benefit QBS provided was ensuring that an experienced team was put on the project instead of a cheaper, but possibly much less competent team. Due to the benefits of having an experienced team, the designers designated this case as having a high level of project success. Based on the feedback by the lead design firm, this project showcases how QBS produces the right outcomes for success on any type of project, not just incredibly innovative or complex projects.

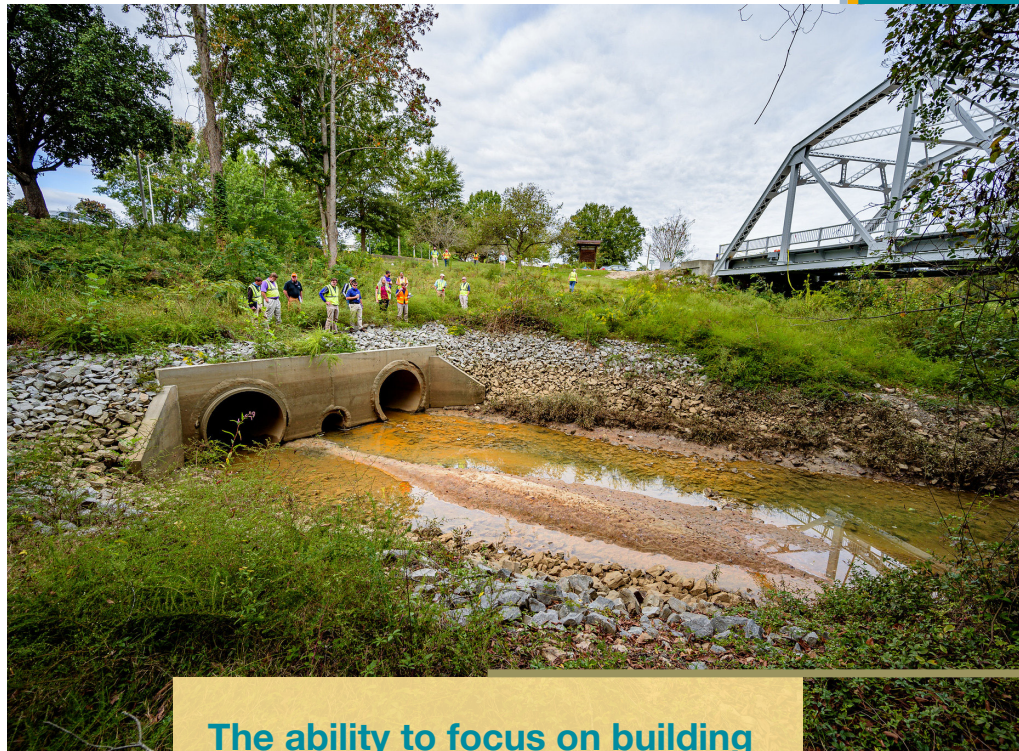
Town Creek Culvert

The Town Creek Culvert project was selected as a case study based on it having a combination of complexity, a modest design fee, a green infrastructure demonstration, and a QBS procurement method. The core of the project focused on stormwater and flood control, but the project also incorporated water, sewer, natural gas, and telecommunications improvements. The greater context of the Culvert project describes it as a complex rehabilitation project in a crowded urban area that required not only large-scale construction in downtown and across a college campus but also added important green infrastructure components needed to attenuate polluted runoff into a nearby river.

The project is an example of how QBS can require engineering firms to team in ways that provide the owner with the greatest set of qualifications to complete the project successfully. In this effort, the lead design firm teamed with other design firms to develop a set of unique solutions that combined their individual strengths in green infrastructure, stormwater systems, and community engagement. This combination of strengths was required to address the breadth of challenges incorporated in the project, including contaminated soils, a downtown location with limited access, high water tables, structural concerns of neighboring buildings, the site being on a college campus, and a hurricane that dropped 36" of rain on the site during construction.

In the end, the project met and even exceeded the expectations of the owner and the team. The team believes this was the case primarily because of the team that was put together to address the challenges. By harnessing the different strengths of the individual offices, the team was able to focus on its experience and qualifications rather than offering the lowest cost. These qualifications allowed the team to minimize interruptions during the project, rise to the level of complexity of the effort, and introduce innovative green infrastructure solutions in the final design.

From the perspective of this study, the project highlights how complexity and qualifications tie together in terms of meeting the needs of a client as well as the general public served by the project. Complex projects, even ones such as this that are of modest size, can require design and construction teams to develop unique solutions to meet the needs of the project. In this case, the scenario of creating an infrastructure project adjacent to existing buildings in a college campus presented several unique challenges. The ability to focus on building a team with the necessary experience that could successfully develop solutions to those challenges was a key to the project's success. This team development was enabled by the QBS procurement method utilized in the project.



The ability to focus on building a team with the necessary experience that could successfully develop solutions to those challenges was a key to the project's success.

Ripken Experience

The Ripken Experience is a unique investment by the city of Pigeon Forge, TN, into increasing city revenues through enhanced athletic facilities. The city's objective was to develop a youth baseball complex that would spur adjacent development and support local tourism. The project was selected as a case study due to it being a unique project, but also because it required close cooperation between the design team and the city to meet specific objectives. The project also had a significant design challenge. Specifically, more than 2 million cubic yards of earthwork and rock cuts were required to create the area for the six baseball fields tucked into the side of a mountain overlooking the city. Additionally, the design team worked closely with the city and Ripken Baseball (operator of the complex) to make sure the team and fan experience is best in class. From WiFi availability across the complex to green infrastructure/low impact stormwater design and outfield fences that were designed to replicate professional baseball stadium fences (e.g., Camden Yards), the design focused on innovation.

The key to the project's success was a team that worked closely together to develop solutions to the technical challenges—in particular, determining the challenges of the site constraints, including the amount of rock that would be required to be cut and removed. These technical challenges required a team that had experience in the technical challenges of athletic field design as well as in the challenges of stormwater management on such a large site with unique drainage requirements. The QBS process provided the opportunity for such a team to be developed for this project with an understanding that the qualifications and experience needed for this type of project were in place prior to the start of the project.

In addition to the specific requirements for design experience, the project included construction challenges that required specific expertise. Working with large athletic fields and synthetic turf, as well as the ability to manage the site development process, were key requirements. The team believes that QBS was a key element in allowing such expertise to be brought to the project and ensuring a successful completion.

In terms of the study perspectives, the use of QBS illustrated how an experienced team brings enhanced innovation to a project that is intended to be a national showcase and a key economic driver for a city. The team was able to meet the objectives and deliver a project that ultimately exceeded the owner's expectations in terms of revenue generation. The combination of experience and a focus on innovation moved this project from satisfying the participants' expectations to exceeding their expectations.



The key to the project's success was a team that worked closely together to develop solutions to the technical challenges—in particular, determining the challenges of the site constraints, including the amount of rock that would be required to be cut and removed.



Columbus State Community College School of Culinary Arts

The Columbus State Community College School of Culinary Arts in Columbus, Ohio, was a QBS project that emphasized design team collaboration to solve structural and mechanical issues in an academic building that was under tight schedule restrictions. Combining culinary teaching spaces with a large auditorium, the project included elements of large assembly space design with highly technical culinary solutions. Combined with an owner that did not build large projects on a regular basis, the project had the potential to run into multiple delays. However, this was a case of a design team working closely together to meet the aesthetic, technical, and construction needs laid out by the college.

The primary challenge in this project, and the one that made it a nice case study example, was the need to solve a series of technical design challenges under a constrained time frame while working with a less experienced owner. In terms of the design challenges, the team needed to address the seismic concerns of a large auditorium together with the electrical and mechanical needs of the teaching spaces. These were then enhanced by discussions over the material that should be selected for the overall structural design.

The demands introduced by working in a college environment where academic schedules impact the project schedule created challenges for the project. Schedules were adjusted to accommodate these constraints, as well as increasing the use of subcontractors to enhance the pace of construction to meet schedule milestones.

However, even with these challenges, the project turned out to be successful as the team met the multiple constraints required by the owner. From the research perspective, the project demonstrated the ability for an experienced design team to meet unique challenges under tight schedule constraints with a less experienced owner. It is questionable whether this level of success could have been achieved if QBS was not the procurement system in place for the project.

Combining culinary teaching spaces with a large auditorium, the project included elements of large assembly space design with highly technical culinary solutions.





Case Study Perspectives

The case study analysis provided the research team with a set of perspectives that complemented the previous data collection efforts. The cross-section of projects provided a set of data from which comparisons could be made in terms of the multiple perspectives that served as focal points for the case studies. From this analysis, the following perspectives were developed:

- › **QBS Provides Depth of Understanding** – An underlying perspective of the project participants was that the ability to bring a qualified team to a project provided owners with the opportunity to leverage that team's experience to gain a better understanding of the risks and challenges associated with a project.
- › **Understanding Responsibilities are Key** – The separation of design and construction responsibilities reduced the likelihood that misunderstandings around roles and responsibilities on the project would develop. The project participants held a strong belief that owner organizations need to be fully aware of the potential challenges associated with new procurement methodologies that blur the lines between design and construction.
- › **Outside Challenges Require Experience** – Projects that have external challenges such as political, social, or community engagement issues require project participants with experience in these areas. In several case studies, the participants specifically noted the need to coordinate community engagement efforts across the team and the benefits that resulted from the team having had experience in these matters.
- › **Experienced Teams Bring Innovation** – Regardless of the overall scope of a project, innovative solutions allow project participants to examine appropriate approaches to the project solution. In almost all cases, projects that had experienced teams also had innovative solutions that enhanced the project. Put a different way; the teams were not limited by a low-cost approach on design fees.
- › **Owner Capacity Influenced Procurement Approaches** – Similar to the conclusions drawn from the larger project populations, the case studies emphasized the challenge of procurement in scenarios with limited owner procurement capacity. Specifically, whether it was areas with smaller populations, or local jurisdictions, the capacity of the owner organization to engage with the procurement process or to fully understand procurement alternatives directly impacted the use of QBS. While QBS may be the legal requirement of a state, the actual application of the process was much more nuanced in practice.
- › **Participant Satisfaction Correlates with Procurement System** – While the case studies are a limited population, they do indicate a correlation between the procurement method and the level of satisfaction of the project participants. The reasons for this correlation vary, but the underlying observation is that participants who approached the project from a perspective of bringing innovative solutions had greater satisfaction than those who approached the project from a cost-cutting perspective.

Regardless of the overall scope of a project, innovative solutions allow project participants to examine appropriate approaches to the project solution.



Overall Conclusions

The completion of the case studies provided an opportunity for the research team to take a vertical analysis of the data collected for the study. Specifically, the research team compared results from 1) previous studies, 2) the impressions provided by the state directors, 3) detailed project information obtained in the project surveys, and 4) the case study perspectives. This broad set of data provided an opportunity to validate assumptions developed from one set of data against the data obtained from the other data collection efforts. Thus, the research team took these multiple perspectives and developed the following overall conclusions from the study.

- › **QBS Saves Time and Money** – When the foundational project metrics of cost and schedule are considered, QBS outperforms the national average in both areas. Analysis of these numbers indicates there is a correlation between design team experience and the quality of construction documents which leads to reductions in construction cost and project schedule.
- › **QBS Benefits Complex Projects** – In this study, we observe that all types of projects derive significant value from the use of QBS procurement. This is particularly true for complex projects that can benefit from experienced and stable design teams comprised of high-quality providers. Complexity can emerge from numerous points in a project including community engagement, political or social sensitivities, technical challenges in design or in construction, or management and collaboration of project participants. In short, the complexity of a project can emerge from multiple known or unknown project elements, each of which benefits from the experience identified through QBS procurement.
- › **QBS Leads to Innovation** – Innovation is a cornerstone of advancing project goals as well as developing better solutions for clients. Innovation can occur on projects of any size or in any sector. This study found that projects that used QBS procurement for design services have a greater likelihood of producing innovative solutions. This is often based on firms having greater opportunity to explore innovations and collaborations when price is not the driving factor.

- › **QBS Enhances Construction Process** – While QBS focuses on design, the selection of design firms with greater experience in key project components, including developing construction documents, assisting in setting requirements for the selection of construction firms, and defining clear project roles and responsibilities, will result in fewer project delays and greater likelihood of owner satisfaction with the overall project.
- › **Reduced Procurement Capacity** – A trend creating questions for QBS stems from the relatively lean staffing and high turnover within state and local governments. As such, education is required to ensure that procurement officials do not have misperceptions about QBS in terms of short-term project costs.

In summary, the current research effort again reiterates the project delivery benefits that QBS provides to owners on all types of projects. The data indicate that QBS continues to enhance project outcomes and owner satisfaction. Of particular importance is the study's finding that QBS projects met all project delivery schedules at a 50 percent higher rate than non-QBS projects. Additionally, QBS projects consistently outperform the national average for projects in terms of both cost and schedule. This reiterates the overall cost and schedule savings.

References

- Adamtey, S. A.** (2020). An empirical study to assist owners in selecting the right procurement method for design-build projects. *International Journal of Construction Education and Research*, 1-18.
- Burati Jr, J. L., Farrington, J. J., & Ledbetter, W. B.** (1992). Causes of quality deviations in design and construction. *Journal of Construction Engineering and Management*, 118(1), 34-49.
- Christodoulou S.** Study on Procurement of Architectural and Engineering Services for Public Works: Case for Qualifications-Based Selection. *Transportation Research Record*. 2003;1861(1):151-160. doi:[10.3141/1861-16](https://doi.org/10.3141/1861-16).
- El Wardani, M. A., Messner, J. I., & Horman, M. J.** (2006). Comparing procurement methods for design-build projects. *Journal of Construction Engineering and Management*, 132(3), 230-238.
- Gransberg, D. D., Touran, A., & Scheepbouwer, E.** (2020). Qualifications-Based Selection of Consultants and Contractors: Breaking The Lowest Tender Price Culture.
- Lines, B. C., & Shalwani, A.** (2019). Procurement of Architecture and Engineering Services: Influence of Cost on Selection Outcomes and Evaluation Criteria That Best Differentiate Consultant Expertise. *Journal of Architectural Engineering*, 25(1), 04019002.
- Love, P. E.** (2002). Influence of project type and procurement method on rework costs in building construction projects. *Journal of Construction Engineering and Management*, 128(1), 18-29.
- Molenaar, K. R., Songer, A. D., & Barash, M.** (1999). Public-sector design/build evolution and performance. *Journal of Management in Engineering*, 15(2), 54-62.
- Nguyen, P. H., Lines, B. C., & Tran, D. Q.** (2018). Best-value procurement in design-bid-build construction projects: Empirical analysis of selection outcomes. *Journal of Construction Engineering and Management*, 144(10), 04018093.
- Shalwani, A. S.** (2017). *A Quantitative Analysis of Architectural and Engineering Procurement: Effects of Cost Inclusion on Procurement Outcomes Compared to Qualifications-Based Selection* (Doctoral dissertation, University of Kansas).
- Tran, D. Q., Diraviam, G., & Minchin Jr, R. E.** (2018). Performance of highway design-bid-build and design-build projects by work types. *Journal of Construction Engineering and Management*, 144(2), 04017112.



acecresearchinstitute.org

202.347.7474

institute@acec.org

