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Design administration in DB projects

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Design administration in DB projects

by

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NOMENCLATURE

AIA	American Institute of Architects
BIM	Building Information Modeling
DB	Design-Build
DBB	Design-Bid-Build
DBIA	Design Build Institute of America
FHWA	Federal Highway Administration
NCHRP	The National Cooperative Highway Reseach Program
TRB	Transportation Research Board

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ABSTRACT

The quality of construction projects are often defined in the design. Since design is subjective, the management of the design process is considerably more difficult than the management of construction. The research seeks to establish the industry practices that are most effective in design administration for mitigating the risk of cost and time growth due to scope creep during the design process in commercial design-build projects. The research maps an extensive content analysis of relevant literature against an industry survey and structured interviews with construction professional to determine the best practices of design administration in design-build projects. Data analysis tools such as the importance index were applied the survey results to examine the Likert items in the survey. This methodology incorporated also incorporated the triangulation strategy which validated the research to uncover the industry's perceptions of successful design administration. This paper integrates the research conclusions into a framework that can be referenced by design-build firms to ensure effective management of the design process.

CHAPTER 1

INTRODUCTION

Background

Regardless of the project delivery method used to deliver a project, construction quality is defined during the design phase. Lewis (2005) posits that construction quality is in fact the product of the "project management triangle of scope, cost, and time." Project delivery can generally be viewed as a optimizing the project's cost, schedule, and quality (as defined by the design documents). See Figure 1.1 for the level of design completion as it relates to project delivery method. In the traditional design-bid-build (DBB) delivery system, the final constructed quality is established by furnishing a set of construction documents based on completed design upon which the contractors bid to build by a specified contract completion date (Ellis et al, 1991). Thus, the only leg of the variable side of the triangle is the bid price. Therefore DBB, by definition, is a system where the constructor tells the owner how much it will cost to deliver the quality defined in the design within the specified period of performance.

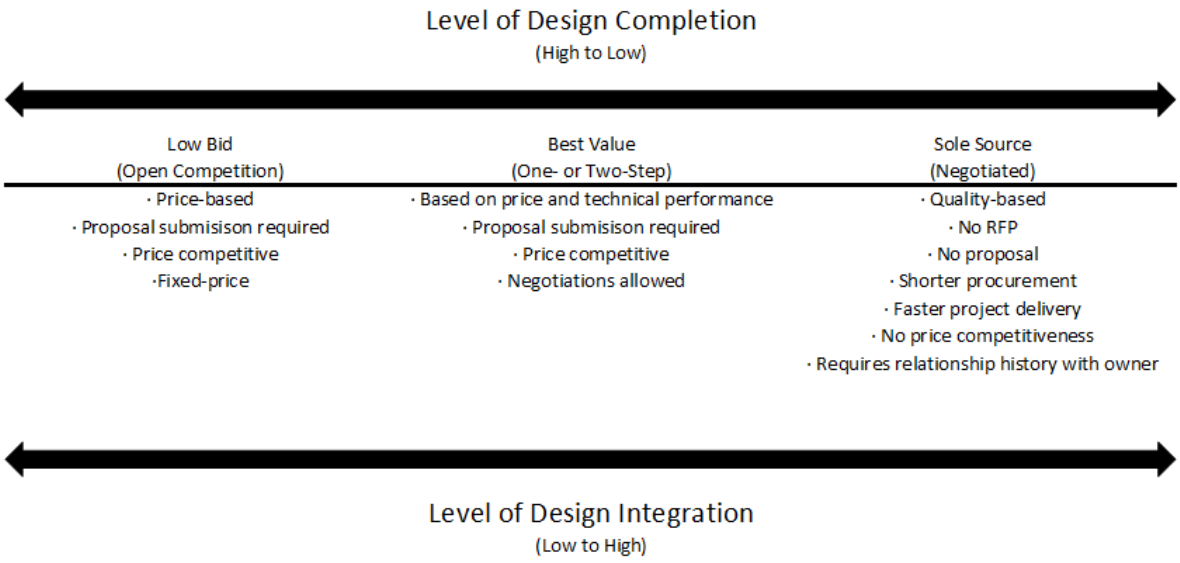

Figure 1.1 Level of Design Completion (Molenaar and Gransberg, 2001).

Design-build (DB), on the other hand, requires the design-builder to commit to a firm fixed price for a project whose scope is defined by a set of performance criteria within a specified period of time (Molenaar and Gransberg, 2001). Therefore, the variable side of DB triangle is the details of design (the quality of final constructed product). "This puts the design-builder in a position where the details of design, and hence the resultant level of quality, are constrained by both the budget and the schedule. In other words, the design-builder must design to cost and schedule" (Gransberg and Molenaar 2004). Therefore this research aims to study the design administration process in DB commercial construction projects and identify those practices that encourage the successful completion of a given design that conforms to both budget and schedule constraints.

The literature contains many studies that report on the results of DB project delivery in the public sector (Chan et al. 2001; Chan et al. 2002; Gatti et al; 2014, Fernane 2011). Most are focused on the delivery of heavy civil infrastructure projects. For example, the Federal Highway Administration (FHWA) published a report to Congress on the effectiveness of DB in highway construction (FHWA 2006). More recently, the need to upgrade and replace much of the nation's highway network (ASCE 2010) resulted in public transportation agencies turning to DB as a way to deliver infrastructure projects "better, faster, cheaper" (Atzei et al. 1999). Interestingly, a distinct emphasis has been placed on faster as evidenced by the FHWA *Every Day Counts* (EDC) initiative. The program seeks to accelerate the adoption and implementation of proven practices that are available for use today. FHWA Administrator Victor Mendez stated: "Our society and our industry face an unprecedented list of challenges... But it is not enough to simply address those challenges. *We need to do it with a new sense of urgency*. It's that quality—*urgency*—that I've tried to capture in our initiative, Every Day Counts." (Mendez 2010, italics added). Using alternative project delivery methods is one EDC approach to expediting project delivery.

> "EDC is designed to identify and deploy innovation aimed at *shortening project delivery*, enhancing the safety of our roadways, and protecting the environment… it's imperative we pursue better, faster, and *smarter ways of doing business*" (Mendez 2010, italics added).

Note that Administrator Mendez changed the "better, faster, cheaper mantra" to "better, faster, and **smarter**." One of the "smarter" approaches to DB project delivery in the commercial

building industry is the use of Building Information Modeling (BIM), which will be discussed in Chapter 2.

Design-build contracting in commercial construction

DB requires the owner to release control over the details of design to the design-builder (Beard et al. 2001), which often takes the form of a general contractor teamed with an architect in either a joint venture or subcontract relationship (Koch et al. 2010). The idea that the owner no longer directly influences each design detail makes DB controversial because there is a fear is that its use might degrade the ultimate quality of the constructed product by compromising the integrity of the design process. This fear is exacerbated by the accelerated pace at which DB projects are delivered. An early study by Songer and Molenaar (1996) found that owners select DB to compress the delivery schedule as much as possible. As a result, DB is often associated with aggressive construction schedules in which the design team is under enormous pressure to not only get the design completed, but also to ensure that it does not exceed the proposed budget. In fact, the Design Build Institute of America (DBIA) Design Build Manual of Practice (2010) advocates: "going *directly from design calculations to pricing*, establishing a quantitative framework within which the *design professionals later execute the final design*" (italics added). The idea of bypassing the drawing of plans, which permit a traditional review, by moving from design calculations directly to pricing, is the basis for the fear that design quality will be degraded by both the process and the speed at which it is implemented.

DB is based on an integrated team approach to the planning, design, and construction of a project, to control schedule and budget, and to assure quality for the project owner. DB projects involve a single contract for both design and construction between the owner and the design-builder. The design-builder has the capability to complete the design and then build the project in accordance with the released for construction design documents (DeWitt et al. 2005). Reaching the stage where partial plans can be released for early construction is a function of the design-builder's design administration process, which is an area in which almost no objective research has been conducted. What little that has been done is almost entirely pertains to the public sector (Chan et al. 2001; Chan et al. 2002; Gatti et al; 2014, Fernane 2011) where it is easy to pull data from the public domain. Therefore, there is a pressing need to study the topic of DB design administration in the private sector where there is far less regulation but also far more post-construction financial impact. To fill that gap in the body of knowledge, this thesis will propose a framework for conducting design administration in private commercial DB projects.

Definitions and concepts:

The following terms are defined as shown below:

- *Design-Build (DB)*: "A method of project delivery in which one entity – the DB team – works under a single contract with the project owner to provide design and construction services. One entity, one contract, one unified flow of work from initial concept through completion – thereby re-integrating the roles of designer and constructor" (DBIA 2015).
- *Design Administration*: "The effective management of the design process" (Johansen and Carson, 2003).

- *Scope Creep*: "A process where additional work is added to the project after the scope has been established" (Kuprenas and Nasr, 2003).
- *Cost Growth:* Unexpected costs incurred in excess of budgeted cost (dictionary.com, 2016).
- *Time Growth*: Unexpected lengthening of project schedule (dictionary.com, 2016).
- *Integration: "*One entity drives one unified flow of work from initial concept to completion*"* (DBIA Best Practices 2013).

Motivation

Since most commercial projects originate in a pro forma financial analysis of the project's potential revenue (Tunstall 2006), meeting or beating the project's completion date can have a huge impact on its commercial viability. Therefore, getting a partial design product completed to a point where those early features of work like site development, drainage, and excavation for foundations becomes important. This requires a robust design administration system and to do so without exceeding the project's budget requires the design-builder to place a heavy emphasis on the inevitable scope creep that occurs during an iterative design process. As a result, the analytical work completed for this thesis placed a special emphasis on identifying effective practices to control scope creep. Project cost and time growth is a direct result of scope creep and the typical subjects focus of past DB research. Scope creep is insidious as it is the result of innumerable small, undocumented decisions made during the design process (Kuprenas and Nasr, 2003). Therefore, the proposed framework for DB design administration documented

in Chapter 5 was developed on the premise that if the design-builder can control scope creep, it will also be controlling control of both DB project cost and time growth.

Objective

The objective of this research is to develop a framework for implementing effective design administration practices for design-builders with an emphasis on controlling scope creep during the design of a commercial building DB project. The framework will include:

- A review and synthesis of experiences gained by architectural designers and general contractors for the management of design services on a DB commercial building project;
- Critical assessments of the relative merits of alternative approaches to managing key aspects of the design that affect project scope, quality, and cost;
- Lessons learned from design administration of DB projects that may be effectively applied under other project delivery methods.

The research seeks to answer the following question:

What industry practices are effective for managing the risk of cost and time growth, due to scope creep during the design process after the design-build contract is awarded?

Content Organization

This thesis is organized into six chapters. Chapter 1 is the introduction to the thesis and seeks to describe the research in general terms as well as articulate the background and

motivation behind it. Chapter 2 contains the literature review on the topic of DB design administration. Chapter 3 describes the overall approach to the research methodology and the research instruments. Chapter 4 details the analysis of the data collection effort and identifies the trends observed. Chapter 5 presents the conclusions reached in the research as well as the limitations of those conclusions. Chapter 6 depicts the contribution made to the body of knowledge and, lastly, the recommendations for future research on the topic.

CHAPTER 2

LITERATURE REVIEW

The literature to date has merely glazed over the topic of design administration. Most research elaborates the success stories in the public sector of DB projects. The research completed on the issue design administration provides many qualitative results through surveys and case studies. The purpose of the literature review was to gain knowledge of the different methods that aid in the successful execution of design administration. The literature review also served as a foundation for the industry survey and structured interview questions that will be discussed in Chapter 3.

Introduction

The DB procurement method has expanded in the construction industry over the past two decades. It has become more commonly the procurement method-of-choice by clients because of its various benefits. Like other traditionally-used procurement methods, factors such as cost, schedule, and quality are determinants of a DB project's success. Also similar to traditional procurement methods, the management of the design process is problematic to project delivery, except in DB, the design process plays an even greater role. While much research has been done to implement a successful design administration plan, it continues to be an issue in DB project delivery.

Design-Build Project Delivery

The construction industry uses different types of procurement methods to warrant delivery of a project. The DB project procurement method has been on the rise in the U.S. construction industry over the past ten years according to a study completed by the U.S. Department of Transportation (FHWA 2014). Although DB is considered to be a relatively novel procurement method, the idea is based off a 4,000 year old concept (Tyler 2010). In ancient times, the master builder was the sole source for design and construction of projects. Today, the idea of integrating planning, design, and construction in a team setting to build a project has grown in popularity for the cost-conscious construction industry.

In a study conducted at Penn State, the DB method was identified as offering on average the best project performance of all procurement methods (Konchar and Sanvido 1998). Despite this discovery, public agencies in only 20 states are permitted to employ the DB method for all types of construction projects without restrictions. In the 30 other states, DB is limited to either public buildings only or the delivery of a fixed number of DB pilot projects (Fernane 2011).

While selecting a project delivery method is primarily client preference, several studies have been conducted that provide evidence of the benefits accrued by using DB over other traditional procurement methods. DB is considered to have numourous advantages including cost control, projects schedule reduction, value engineering opportunities (Fernane, 2011). Refer to Table 2.1 for a list of DB advantages and disadvantages composed through literary research.

Table 2.1. Design-Build Advantages and Disadvantages

Advantages	Disadvantages
Improves: • Cost • Timing • Quality • Value • Safety • Efficiency • Value Engineering • Innovation • Collaboration Reduces: • Risk • RFIs • Change Orders • Claims • Design Issues Verifies: • Prices • Labor Availability • Constructability Identifies: • Design Errors • Ambiguous Specifications • Costly Features • Hard-to-Build Features	Allows for: • Non-Competitive Pricing • Turf Wars • Reduced Owner Control and Input • More Complex Design Process • More Design Cost • Added Cost and Time at Front-End • Quality Assurance Concerns • Liability Concerns • "Too Many Cooks in the Kitchen"

Still, many owners lean towards the security and familiarity of more traditional methods such as design-bid-build (DBB). DBB is a process in which the owner contracts separately with the designer and general contractor involves three primary steps: 1) the design phase, 2) the bidding phase, and 3) the construction phase. On the other hand, DB provides a contract where a single legal entity furnishes both design and construction services (Fernane 2010). This is often accomplished through a firm that specializes in DB, although it is possible for an architect and

contractor to joint-venture. Figures 2.1 and 2.2 illustrate the contractual relationship in the DBB and DB procurement methods.

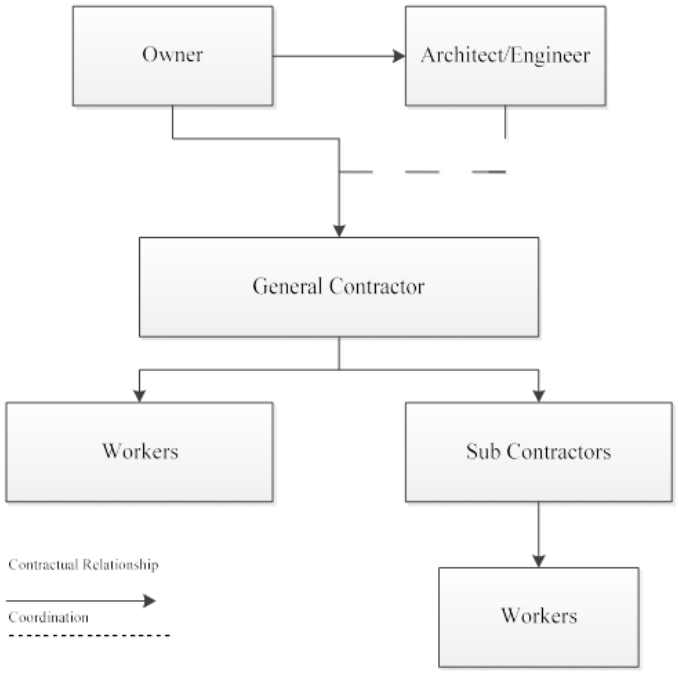

Figure 2.1. Design-Bid-Build Contractual Relationship (Fernane, 2010)

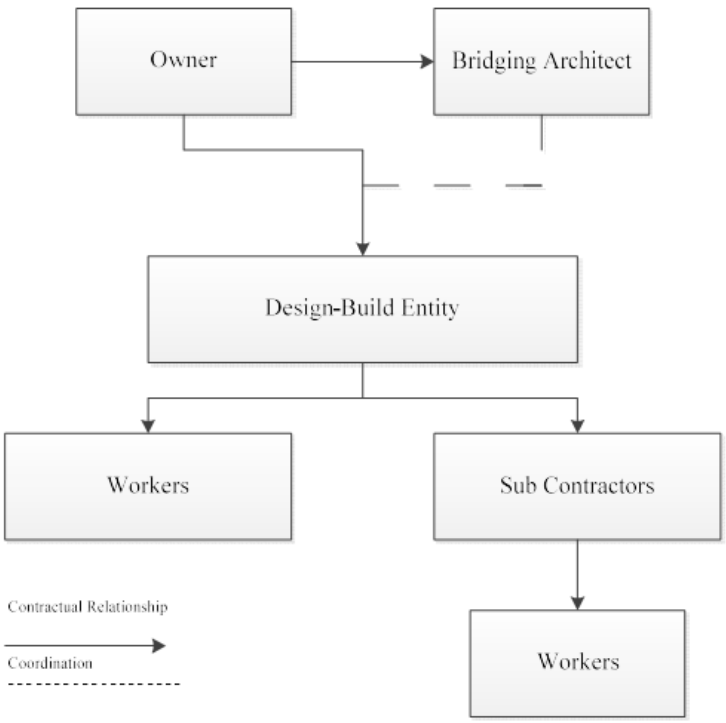

Figure 2.2. Design-Build Contractual Relationship (Fernane, 2010)

In 2001, Allen completed a study involving a comprehensive investigation of performance metrics, such as cost, schedule, and quality, to compare DB and design-bid-build. Allen analyzed data from 110 military construction projects from the years of 1996 to 2000 to quantify the performance of each project procurement method. The quantitative data found in the study determined that the cost and time growth was significantly higher in the DBB method than DB. This could be attributed to factors such as design error or unforeseen conditions. The study also concluded, based on a survey, that DB is judged to be equal if not better in overall quality.

In another comparative study regarding DB and DBB, Fernane (2011) collected data, by a means of random sampling, from construction projects at United States universities, public and private. During the data collection phase, Fernane discovered that many universities were using only DBB or Construction Manager at Risk methods. Approximately 300 questionnaires were sent to 230 universities to obtain project information. Of the 300 questionnaires, only 84 were deemed valid (42 DB projects, 42 DBB projects) for analysis. Several statistical tests, including an Analysis of Variance (ANOVA) test, a Levine's test, an Anderson Darling test, and a t-test of unequal variances, were performed to determine metrics related to cost, schedule, and change orders. A factor adjustment was used on the project cost using the building cost index and local index to properly analyze the cost data. Through a means of testing of ten pre-determined hypotheses, Fernane made several findings in relation to the data. Similar to the study performed by Allen, the cost and time growth were higher in DBB projects. Fernane found that, on average, DB projects were completed three times faster than DBB projects. Fernane (2011) also found that overall change order growth is lower in DB projects than DBB projects.

In the DB process, projects can be designed while considering the most cost-effective materials and methods. Money often drives the decision of whether a project is going to be built, so budget-conscious designs are encouraged. DB allows for construction costs to be realigned during design through a value engineering process (Tyler 2010). Since, designers do not have access to construction costs in the DBB process; it is a possibility that re-design may occur to reduce construction costs. Often times, DB requires a sole-sourced contract awarded based on a good-standing relationship between the owner and the design-builder. A noteworthy pitfall of

DB is the lack of competition market can produce high bid costs, whereas the bidding phase in DBB creates a competitive scenario for the tenders resulting in the best price possible (Johansen and Carson2003). Refer to Table 2.2 for a comparison of DB to other traditional delivery methods.

Table 2.2 Project Delivery Method Comparison (DBIA, 2015)

Metric	DB vs.DBB	DB vs. CM at Risk
Unit Cost	6.1% lower	4.5% lower
Construction Speed	12% faster	7% faster
Delivery Speed	33.5% faster	23.5% faster
Cost Growth	5.2% les	12.6% less
Schedule Growth	11.4% less	2.2% less

DB eliminates the bidding phase which shortens the overall design and construction process. In DB, the design and construction process occur simultaneously, so ground-breaking can ensue before the design is completed. DBB requires the architect to finalize the design before the contract is executed forcing each phase to be accomplished sequentially; which can lengthen the project development schedule.

The integrated services that DB delivery utilizes have the potential to reduce conflict during the project's development. Designers are able to utilize the general contractors' experience to address in constructability issues, such as errors, ambiguous specifications, costly

elements, and hard-to-build features, early in the design phase. This can help reduce the number of requests for information (RFIs) and changes order requests.

In DBB, the owner is involved with multiple points of contact throughout the project increasing liability and confusion (Allen 2001). DB involves a single entity for design and construction, one point of contact, and one contract which minimizes the time spent in the administrative details of the procurement. In DBB, the owner has contractual privity with both the designer and constructor, which may increase at risk for design errors and omissions. However, the construction contractor has no mechanism to provide input to the design except through post-award contractor value engineering proposals. DB transfers the much of the design errors and omissions risk from the owner to the design-builder (Tyler 2010). In doing so, the owner now has less control over the details of the design, which ultimately establish the standard for construction quality. Shifting the design performance risk generally reduces the number of owner's design resources needed.

DBB and DB are two diverse project delivery methods, but it is ultimately the owner's preference for the choice of delivery method. The cost and schedule benefits of DB have been found to reduce cost and time growth due to design errors and omissions found in the other traditional methods. The major risk to the owner in DB delivery lies in the post-award management of the remaining design activities once a lump sum contract amount has been established in a manner that permits construction phase to commence as planned in the project's contractual schedule requirements.

Design-Build Project Success

"Success has always been the ultimate goal of every activity, and a construction project is no exception" (Chan et al. 2002). In the construction industry, project success is an abstruse term often characterized by perception. Often times, the idea of project success lacks consensus. Time, cost, and quality are typically considered to be the success factors for all types of project procurement methods. These factors have been criticized as "not being comprehensive" (Chan et al. 2002). Studies of the project success in DB have shown there are other subjective and objective measures to determine project success.

In 2001, Chan et al. extracted multiple project success factors utilizing a factor analysis of data obtained from a questionnaire taken by 53 participants of public-sector DB projects. The questionnaire respondents provided information regarding project time and cost performance which was then rated on a nine-point scale. Respondents also rated their satisfaction in relation to time, cost, quality of design, and quality of workmanship on a five-point Likert scale. An analysis of the data revealed that of the list of success factors, the three most important were considered to be project team commitment, the client's competency, and the contractor's competency.

More specifically, project team commitment is recognized to be an important factor for smooth operation in DB projects. "Architects, contractors, and subcontractors in successful DB projects understand they work toward a common purpose; they work for each other as much as with each other. To become a successful DB team, the architect needs to appreciate the

knowledge contributed by the contractor and balance their design orientation with issues of constructability, cost, and schedule" (Wilking 2006). The DB procurement method instills a team atmosphere among the designer, contractor, and client. "Mutual trust and respect between client and contractor has been emphasized by practitioners as an important ingredient of DB project success" (Chan et al. 2001).

Since the concept of project success is vague among the industry, Lam et al. (2008) set out to develop a project success index (PSI) for DB projects in hopes of discovering determinants of project success factors. Lam et al. (2008) compiled a comprehensive literature review of high-ranked journals written over a 15 year period about DB projects. This literature review served as background information for an empirical study performed on DB project participants in 2003. The study determined three imporant things:

- "The nature of DB projects is positively associated with its overall success level."
- "More effective project management action increases the overall success of a DB project."
- "More frequent use of innovative management approaches such as value management and partnering canresult in the overall higher success level of DB projects." (Lam et al. 2008)

While several contest that time, cost, and quality are the most qualitative success factors in DB projects, this lumps the DB method in the same category as other procurement methods. The DB method has previously shown its benefit over tradional procurement methods, but not without its design administration challenges.

Design Administration

A study found that "more often than not, the reason for design failures is inadequate design administration rather than unprecedented technical issues" (Williams Jr. and Johnson, 2015). Different theories on the management of design are found throughout the construction industry (Bibby et al. 2003; Doloi 2009; Formoso and Koskela1998; O'Donnell 2002). Many studies have been completed regarding design mamangement. However, there is a dearth of information on how to effectively plan and implement a design administration process for projects delivered using DB.

Past research has shown that a large percentage of shortcomings in construction arise due to the decisions made during the design (Fadamiro and Bobadoye 2006). "Many organizations have found design to be one of the key performance indicators to project success… the design phase of a project alone offers the greatest scope for reduction in overall project costs and adds maximum values in the project" (Doloi 2009). Therefore, when a the design process is deficient, the overall project success is at stake (Fadamiro and Bobadoye 2006). According to a number of authors, inadequate design administration can be characterized by the following factors:

- lack of design administration involvement (Fadamiro and Bobadoye 2006; Gatti et al. 2014)
- lack of implementing design procedures (Fadamiro and Bobadoye 2006; Williams Jr. and Johnson. 2015)
- misunderstanding of the design objectives (Chan et al. 2001; Chan et al. 2005)
- changes to design plans and specifications (Chan et al. 2001; Frederickson 1998)
- lack of a failure risk analysis plan (Chan et al. 2001; Lam et al. 2008)
- ineffective communication transfer process (Williams Jr. and Johnson. 2015; Koch et al. 2010)
- poor organization management (Doloi 2009)
- lack of technical knowledge in designers (Chan et al. 2001; Lam et al. 2008)
- lack of pre-planning by designers (Doloi 2009)
- lack of adequate documentation (Johansen and Carson 2003; Williams Jr. and Johnson 2015)
- unbalanced resource allocation (Chan et al. 2001)
- inconsistent decision-making (Chan et al. 2001; Chan et al. 2005)

Doloi (2009) neatly summarized the problem in this manner:

> "Increasing complexity and sophistication in construction create new challenges in design administration practices. The clients are not only interested in value for money in relation to investment in project development but also in costs associates with operation and maintenance over the project lifecycle. While the client's interest may be profit driven in the competitive markets, the architects or design professionals are responsible for balancing design innovations, sophistications, and cost-effectiveness in the project" (Doloi, 2009).

As Formoso et al. (1998) describes, the design process acknowledges two progressions. The first is the individual decision making process, often performed by a designer, concerned with the creation of alternative solutions. The second is the management process which develop from general and abstract to detailed and concrete. To have a wholistic view of the design process requires considering both progressions. However, in construction, the design process is thought to be a single stage. Formoso et al. (1998) explains this is caused by the participation of the design team starting relativeley late in the project and finishing as soon as the production stage begins. But in DB, design is considered to be one of the most important phases since it occurs from inception to building operation. Refer to Figure 3 for the steps involved in building creation. Though improvements have been made in design administration, there few cases that report success. A complete understanding of the design process and the way information flows between people and organizations is needed. Successful integration of the design process with

the procurement and construction of a project is vital (Johansen and Carson 2003). Another study described the process in this manner:

> "Project team members in design–build system, including owner's representatives, design–build contractors and architects/engineers, have to adopt new roles in managing the design of large-scale projects. The design responsibility is transferred from the owner's organization to the DB contractor who is responsible for the design administration in the projects to be delivered by the design–build procurement system. However, there remains the concern of design administration between the designer and the constructor within the deisgn-build organization, or between the joint venture parties of a DB project" (Chan and Yu, 2005).

In a survey perfomed by Chan et al. (2005), a general consensus, consisting of contractors, consultants, and employers, found that the best party responsible for the design mamanegment process should be the design buildecontractor, not the designer's group. There are several methods that are aimed at better mananging the design process, but most have proven to be inefficient (Ballard and Koskela 1998). Design administration extend further than simply selecting a qualified design manager. There are several factors involved in the management process that enables success.

For instance, the SR 99 bored Tunnel project in Washington is considered to be a remarkable DB project. Gatti et al. (2014) compiled a case study on Washington State Department of

Transportation (WSDOT) and the Dragados-Tutor Perini joint venture (STP – Seattle Tunnel Partners). WSDOT and STP implemented several steps to ensure a seamless design administration effort that included partnering and collaboration efforts and scheduled design reviews.

In another case, an extensive literature review and interview process with industry professionals, Johansen and Carson (2003) were able to find effective tools in design mamanegemt. "Two issues should always be addressed in design; the provision of accurate, fully coordinated, complete information and the timely provision of that information. The first is the responsibility of the lead designer and the second is management" (Johansen and Carson 2003). Through reseach, the authors determine there were five areas that needed improvements in the design administration process: 1) adequate design time, 2) briefing, 3) working in teams, 4) competent design manangers, and 5) design tasks and information interdependencies.

Technology has shown the improve the design administration process. Building Information Modeling (BIM) is 3D model-based process is thought to help designers and contractors plan more effectively and alleviate any rework according to Autodesk (2015). Despite the general wisdom regarding the benefits of BIM, there still seems to be a low adoption rate (50% of U.S. construction industry) per a study conducted by McGraw-Hill in 2009. The best way for technology to be accepted is when the owner requires it in the contract, but selecting a contractor base on the price diminishes the need for the costly technology. BIM seems more prevalent in the private sector due to a value-based contractor selection process, such as DB, as shown by a

survey conducted by Accenture (2001). Porwal and Hewage (2013) conducted a study that tested the efficiency and applicability of BIM. The study revealed that the use of BIM required more details in the schematic design stage, so much so that cost estimators could not rely heavily on the model for pricing exercises. However, BIM did increase the sub consultants, such as steel detailers, involvement in the design stage. While the maturity of BIM is slow in the construction industry, BIM shows a benefit to the design process.

The National Cooperative Highway Reseach Program (NCHRP) published a *Guide for Deisgn Management on DB and Construction Manager / General Contractor Projects* which studied several transportation DB projects. The design administration process was considered effective is it was successful in client organzation, collaborative partnering, quality management, design reviews, and communication (TRB, 2014).

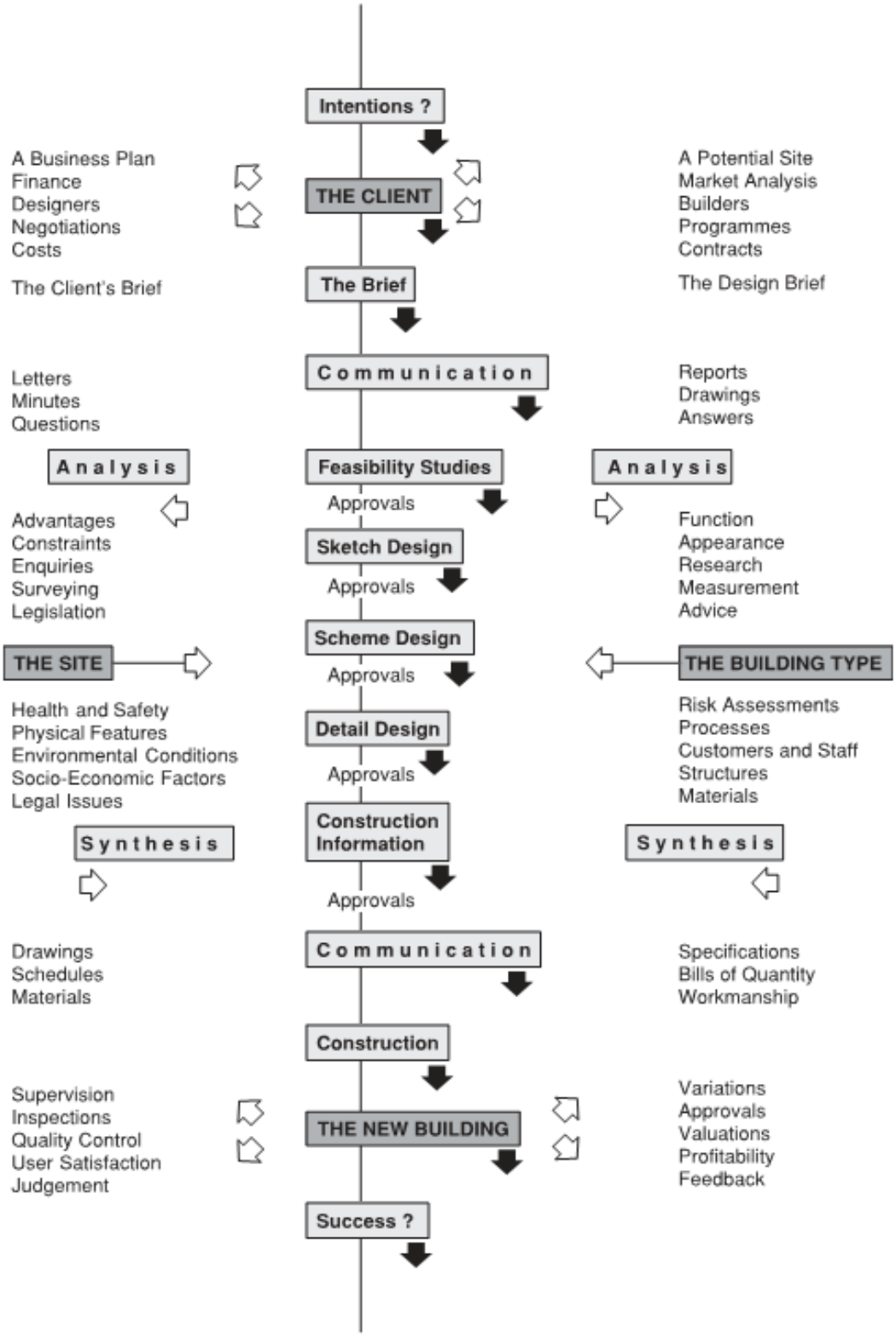

Figure 2.3. Design Steps (Tunstall, 2006)

A number of publications have been put forth on the success factors of design administration, helping draw similarities in certain characteristics that determine effective design administration. Design administration can be improved by incorporating certain tools such as:

- Implementing collaborative partnering (Wilking 2006; Gatti et al. 2014)
- Incorporating a team building charette (Koch et al. 2010)
- Ensuring thorough communication and understanding (Williams Jr. and Johnson 2015)
- Involving all project stakeholders (Chan et al. 2001; Gatti et al. 2014)
- Scheduling design reviews (Fadamiro and Bobadoye 2006; Williams Jr. and Johnson 2015)
- Appointing a design manager (Bibby et al. 2003; Chan et al. 2005)

While the above mentioned tools are a considerable start to a successful design administration process, the design process still needs to be planned and managed more effectively, to minimize effects of complexity and uncertainty.

Conclusion

The separation of design and construction through the DBB procurement method has been blamed for the lack of successful design administration. The DB method had hopes of alleviating the problem by integrating the design and construction process, but while there has been some improvement, projects have shown that design administration is still deficient.

Different strategies have been applied to form a basis of management for the design process but to no avail. The lack of a solid conceptual foundation for design administration is the purpose of the research to follow.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter will detail the methodology used to rigorously collect and evaluate the data received about DB design administration practices. The methodology was designed to test the following hypothesis:

A framework of effective practices can create a foundation for planning the management of the design process in commercial DB projects in a manner that effectively mitigates the risk of scope creep as well as cost and time growth.

The research seeks to attain a list of effective practices that are successful in mitigating cost growth, time growth, and scope creep in DB projects. The theoretical foundation for the framework involves starting by benchmarking the state-of-the-practice in industry based on a formal content analysis of the available literature. As shown in Table 3.1, the first phase is a catalog of theories on and about design administration as applied to the DB project. The result is a set of potential models that can be adapted for use by commercial DB contractors. It includes a set of advantages and disadvantages for each potential model: a baseline theory about the practice. This sets the stage to refine the available models and develop the proposed commercial DB project framework in Phase 2. The necessary topical content for the framework will next be established and organized to document an integrated design administration theory for the practice. The last phase involves putting what has been learned in the previous phases into

practice by creating a knowledge transfer instrument consisting of observed effective practices from the data collected from each of the research instruments. The proposed framework will permit a commercial design-builder to develop a project-specific set of practices to govern the design administration process in a single DB project.

Table 3.1. Research Framework Foundational Theory

Phase I –Theory ABOUT Design Administration Practice	
From Literature and Documents  ***To*** Baseline Design Mgmt Theory	Fundamental understanding of the definitions and salient components of a successful DB design administration program » Code project characteristics and criteria for: ✓ Owner implementation ✓ Procurement/Pricing ✓ Contract Administration » Define current state of practice » Identify DB design administration models » Describing advantages and disadvantages of each model
Phase II – Integrated Design Administration Theory FOR Practice	
From Baseline Theory  ***To*** Integrated Design Mgmt Program Needs	Document the Integrated Design administration Framework topical content » Map a path from the baseline theory to design administration program requirements » Validate the Guide topical content » Organize the Guide topical content
Phase III – Integrated Design Administration Theory IN Practice	
From Integrated Design Mgmt Program Need  ***To*** Integrated Design Mgmt Effective Practices	Document the proposed design administration model(s) » Create the "business" case and key messages for upper management » Map a path from Integrated Design administration program requirements to DB model for program management » Develop decision support for DB design administration model selection » Catalog effective practices for DB design administration

Research Instruments

The study was based on the findings from the following three research instruments:

1. Comprehensive literature review and a formal content analysis of the findings

2. Industry survey focused on design administration and success in DB projects
3. Structured interviews of DB project participants (See Appendix A for IRB approval.)

Content analysis of the literature

These content analyses consisted of gathering and reviewing journal papers, conference presentations, and other documents found in the literature and searching for written material about design administration that were contained in the documents. The content analysis begins by creating a matrix plotting similar successful design administration traits found in the literature.

The matrix governed the formal content analysis and furnishes quantitative measurements of current design-administration factors. They are found by counting the number of times that terms of interest are observed in the literature. This type of analysis can be used to develop "valid inferences from a message, written or visual, using a set of procedures" (Neuendorf 2002). The primary approach is to develop a set of standard topics as they appear in design administration and DB projects into which words that appear in the text of a written document and then the method utilizes the frequency of their appearance as a means to infer the content of the document (Weber 1985). Thus, in this study, the content analysis consisted of two stages. First, of the documents were chosen based on their context regarding DB and design administration. Secondly, that context was used to determine, if possible, as to whether the information was important in the given context. This allowed an inference to be made regarding the authors' relative importance for a specific notion. This method was then repeated with other

terms, such as ”partnering” or “design reviews” that were common to DB design administration systems and the context was recorded and analyzed. The results were then presented in a matrix form where the researcher could map across the other two instruments listed below to find intersections of independently derived information. The full content analysis matrix can be seen found in Appendix B; however Table 3.2 shows a section from the full content analysis for example purposes. If two instruments intersected, the notion under analysis was determined to be a possible effective practice. If the results of all three instruments intersected, the information was labeled conclusive and included in the final framework.

Table 3.2 Example of Content Analysis Matrix

Design Administration Tools	Chan et al. 2001	Gatti et al. 2014	Johansen et al. 2003	Minchin et al. 2014	Times Cited
Partnering	X	X	X	X	4
Internal Design Reviews		X		X	2
Early Contractor Involvement	X	X	X	X	4

Industry survey

The primary research instrument used to document the state-of-the-practice in this area was a web-based survey. The survey questions were fostered from the knowledge gained through the literature review process. The survey questionnaire was prepared based on the principles prescribed by Oppenheim (1992) for survey questionnaire design. The survey served to collect the opinions of a sample size of 35 construction professionals, including owners, designers, design-builders, contractors, and subcontractors.

The survey divided the participants into the following five stakeholder groups:

1. Owners – A person for whom the project is carried out (HSA 2009).
2. Designers – An architect or engineer duly licensed for professional practice, who may be employed by an owner to the purpose of designing a project (The Free Dictionary, 2016).
3. Builders (subcontractors) – A person who performs construction or renovation to a construction project (The Free Dictionary, 2016).
4. Construction managers – A person who is appointed to work as the owner's agent on the construction project (The Free Dictionary, 2016).
5. Design-builders – A building contractor that provides both design and construction services for the client. (The Free Dictionary, 2016).

The survey was split into eight different sections:

1. Introduction – This section essentially summed up the respondent's demographics and current employment information.
2. DB experience – This section requested the details of the respondent's previous DB involvement.
3. Managing cost growth – This section utilized a five-point Likert scale to find the level of agreement in which cost growth can be mitigated.
4. Managing schedule growth – This section utilized a five-point Likert scale to find the level of agreement in which time growth can be mitigated.

5. Managing scope creep risk – This section utilized a five-point Likert scale to find the level of agreement in which scope creep can be mitigated.
6. Expectations and Relationships – This section utilized a five-point Likert scale to find the level of agreement regarding the importance of project team relationships as it relates to meeting the goals of design administration. .
7. Stakeholder input – This section utilized a five-point Likert scale to find the level of agreement in which stakeholder (owner, contractor, or designer) input is beneficial in the design administration process.
8. Design reviews – This section utilized the Likert scale to find the productiveness in the frequency of various design review meetings.

Appendix C contains the details of the questionnaire and the complete set of survey results. The survey consisted of 25 specific questions of which four were open-ended questions where the respondents could explain or amplify their answers to the specific questions. Since multiple-choice surveys often lack in qualitative detail, the use of select short answer boxes mitigates this shortcoming. A random sample of design and construction professionals in the Dallas/Fort Worth Texas area drawn from the members of the American Institute of Architects (AIA) Dallas Chapter and TEXO (one of the largest commercial contractors association of Texas) was solicited with the survey link attached to the organizations' weekly newsletter. That method of solicitation proved to be unsuccessful as only one response was received. A response rate is unable to be determined on the original survey link due to the large platform the AIA and TEXO newsletter reaches. Due to lack of responses, an additional 25 personal emails to general

contractors, designers, owners, and subcontractors were sent requesting that the respondent complete the internet survey. The email was forwarded on to several employees within each company. Again, a response rate is unable to be determined on the second attempt survey link due to the unknown amount of emails that were forwarded. Forty-three responses were ultimately received although only 35 completed the survey in totality. Table 3.3 shows the demographics of the respondents with the biggest response coming from design-builders and general contractors, the two primary entities that hold the prime DB contract (Songer and Molenaar 1996) and who are directly responsible for the design administration process.

Table 3.3 Survey Respondent Demographics.

Industry Role	**Response Count**	**Response Percent**
An owner	2	4.76%
A design professional	5	11.90%
A general contractor	11	26.19%
A design-builder	22	52.38%
A construction manager	2	4.76%
Total	**42**	**100%**

The survey results indicated commonalities on several levels. Both practice and perceptional data was obtained in the survey. Previous research has found that design activities are much harder to quantify than construction activities. This is because design produces intellectual property rather than the physical property produced in construction. Hence, while a footing requiring a fixed amount of concrete is not complete until the fixed amount has been poured, a designer can literally choose when to stop designing. This is exacerbated by the fact that design is inherently iterative and the designer expects to make changes to the original design

as more information is known. Therefore, since a DB project's design must necessarily be within the price at which the contract was awarded and the fact that most DB projects are initiated to accrue the benefits of being able to start construction as soon as practical, the survey respondents perceptions regarding the management of the design process are very cogent to being able to identify effective practices.

Survey analysis

The data assembled from the survey was input into a Microsoft Excel file in the form of a matrix. Frequencies, percentages, and data trends of each question were calculated. The survey was evaluated using two different methods which were dependent on the question types. A majority of the multiple choice questions utilized a Likert scale as the first method. Likert scales are a common type of survey question format. The standard response category for a Likert item is "strongly disagree," "disagree," "neutral," "agree" and "strongly agree" (Garson, 2008). The first method of analysis of the survey responses converted the Likert scale answers into a numeric format to calculate an average weighted score of each Likert item. See Table 3.4 for numeric conversions of the Likert Scale. The average weighted score was used to establish a general consensus of all the respondents.

Table 3.4 Likert Scale Numeric Conversion Chart

Likert Response	Numeric Value
Strongly Disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly Agree	5

The data was then separated by the respondents' industry role where an average weighted score of each Likert item was also determined by group. Each group was compared back to the general consensus of the total responses. Each group was also compared to each other. See Appendix C for the Excel spreadsheet containing the data analysis. The comparisons aided in the discovery of any partiality depending on the industry roles of each respondent.

A second method of analysis was conducted on questions 11 and 12. To remove the potential for unintentional bias being introduced to the analysis of survey responses the Importance Index proposed by Assaf and Al-Hejji (2006), is used to take the results of the descriptive statistical analysis to the next level. The Importance Index is the product of the Frequency Index and Severity Index. In a nutshell, this approach takes the output from responses on a Likert Scale and computes often a given response is observed, the Frequency Index and the relative weight that is given to that response, the Severity Index. Importance is then computed in a manner where those responses that carry the greatest weight that are observed most frequently are deemed to be more important than other responses having less weight and/or found less often.

The index is computed as follows:

$$\text{Frequency Index (FI) (\%)} = \sum a^{*}(n/N)*100/5 \qquad \text{eqn 3.1}$$

Where: a = the weight assigned to each response

n = the frequency of the responses

N = total number of responses

$$\text{Severity Index (SI) (\%)} = \sum a(n/N)*100/5 \qquad \text{eqn 3.2}$$

Where: a = the weight assigned to each response

n = the frequency of the responses

N = total number of responses

$$\text{Importance Index (II) (\%)} = \left[FI(\%) * SI(\%)\right]/100 \qquad \text{eqn 3.3}$$

See Appendix C for the Importance Index calculation of question 11 and 12.

Structured interviews

Subsequent to the survey, structured interviews were conducted on five construction professionals to validate the results obtained from the previous two instruments and permit authoritative conclusions to be drawn. While surveys allow for a larger pool of opinions, interviews provide a more in depth look behind what is driving the industry's opinions. The consistencies derived from the content analysis (Appendix B) and survey results (Appendix C)

offered the groundwork for the structured interview questionnaire (Appendix D) as it related to cost and time growth, scope creep, design managers, design reviews, etc. A copy of the seven question interview can be viewed in Appendix D. The purpose of the interviews is to gain insight of both positive and negative experiences with design administration in DB projects and to understand how to mitigate the risk of cost growth, time growth, and scope creep. The qualitative data collected through the interview process provides a means of support for the research results of the survey and content analysis. .

Table 3.5 Interviewee Demographics

Company	Position	DB experience
JE Dunn	Project Manager	Previously worked with DB firm
Trammell Crow Company	Owner	No DB experience
Beck Group	Managing Director	Currently working for DB firm
Beck Group	Project Manager	Currently working for DB firm
Beck Group	Project Manager	Currently working for DB firm

The interviewees were sent a copy of the questionnaire for review a day before the interview occurred. The interviews were conducted via phone or in person. The structured interviews offered a deeper comprehension of the current industry's opinion of design administration as it

stands in DB that could not be obtained from a survey. The contribution from industry professionals gave inside perspective on the most effective procedures based on experience.

The interviews were mapped against the survey results and a content analysis of the literature review utilizing a triangulation strategy as describe by Jick (1979) to build a framework for the design administration in the design-build process. The interviews served as a validation for the information found in the literature and survey responses. Figure 3.1 graphically illustrates the methodology and how each research instrument relates to all others.

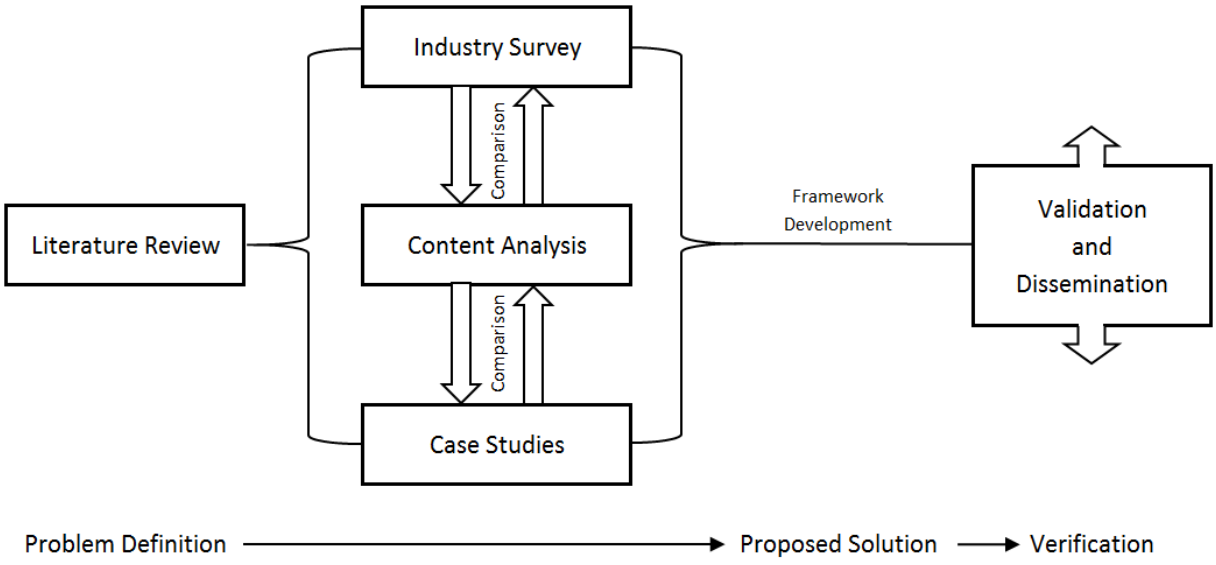

Figure 3.1 Research Methodology Chart

The research anticipates finding an industry-wide agreement in the Dallas Fort Worth area of best practices for design administration in DB projects. The research findings will be

used to develop recommendations and proposed methodologies for designers and contractors to use to manage the design process of DB projects. The framework is intended to aid DB teams, especially designers, to manage the design process more effectively.

CHAPTER 4

DATA ANALYSIS AND RESULTS

Success of a DB project is subjective between industry professionals. DB projects contain many skewed tendencies that can influence the project outcome. Present-day projects are increasing in complexity which generates new challenges for design administration (Doloi 2009). The literature (Bibby et al. 2003; Doloi 2009; Formoso et al. 1998; O'Donnell 2002) provides an extensive amount of information of what-not-to-do. This information has concluded inadequate design administration is one of the primary causes for failure in DB projects. The design defines the quality of a project (Koch et al. 2010). The design phase presents the best opportunities for overall project cost and time (Doloi 2009).

The results of this research were obtained by cross-referencing a content analysis of the literature on the topic of design administration in DB projects with the Dallas / Fort Worth construction industry's perceptions of design administration. Figure 4.1 provides a graphical depiction of the components of design administration success pre-contract award and post-contract award as determined through the literature review process.

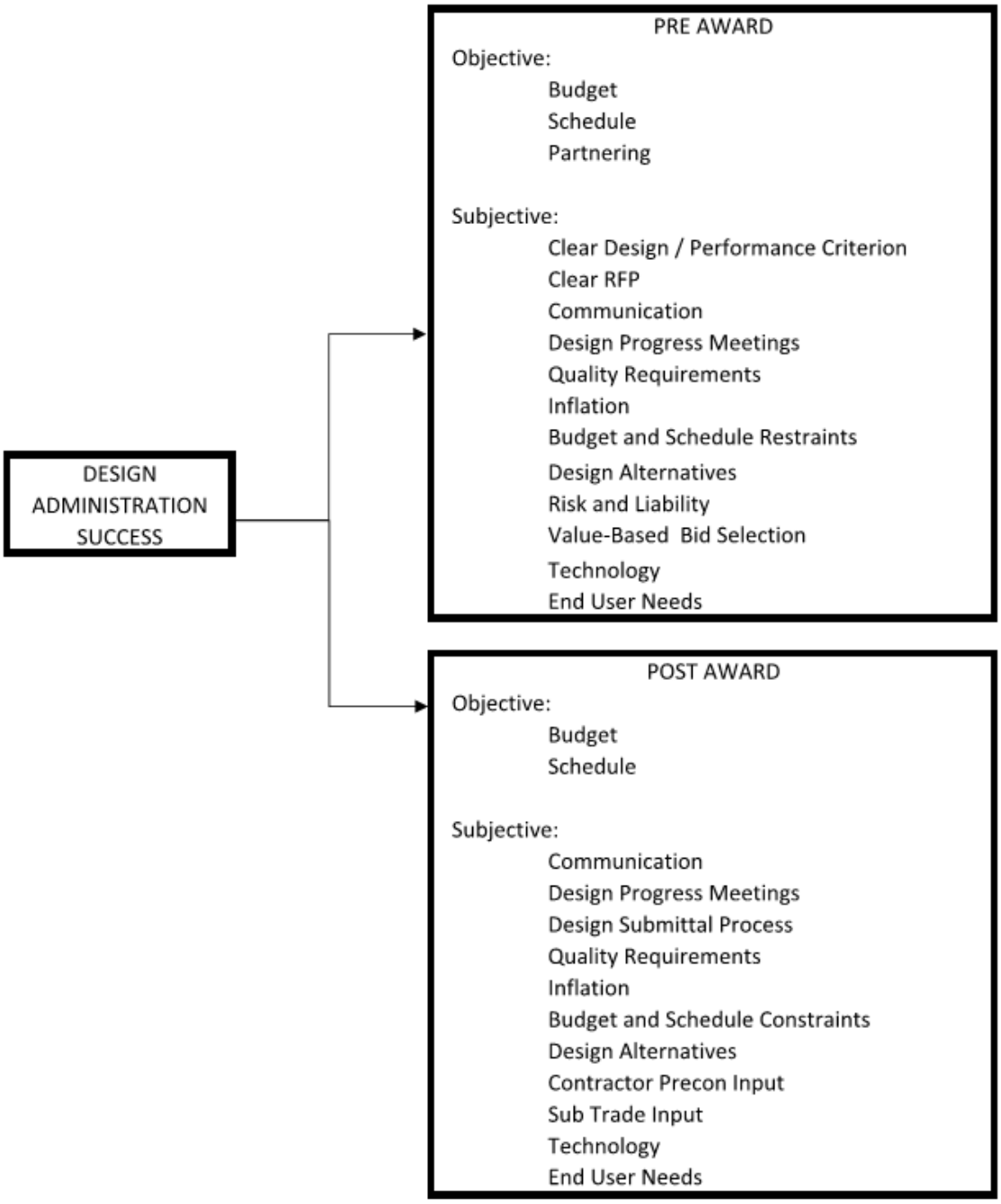

Figure 4.1 Design Administration Success

Establishing Owner Expectations

According to the Design Administration Guide, owners want their projects to meet the intended objectives, within the established budgets and schedules. The owner develops the project goals and requirements and provides the resources for the project. "All projects stem from the needs or objectives of a client" (Chan et al. 2002). All of the survey respondents agree that early establishment of both owner project expectations and the DB team's project expectations are important in design administration for DB projects. See Figure 4.2 and 4.3 for a graphic representation of the survey respondents' opinions of early establishment of project expectations.

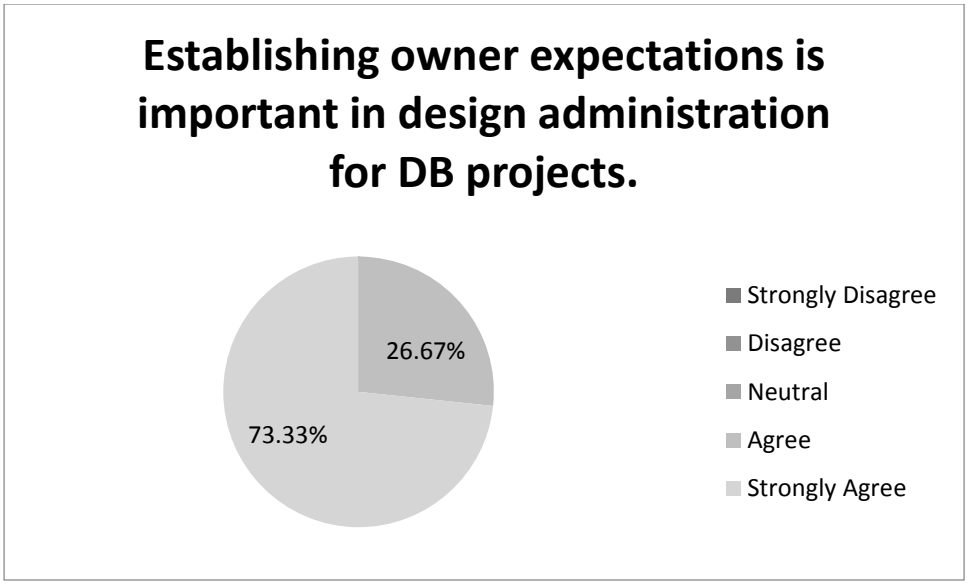

Figure 4.2 Survey Output with regard to Early Establishment of Owner Expectations

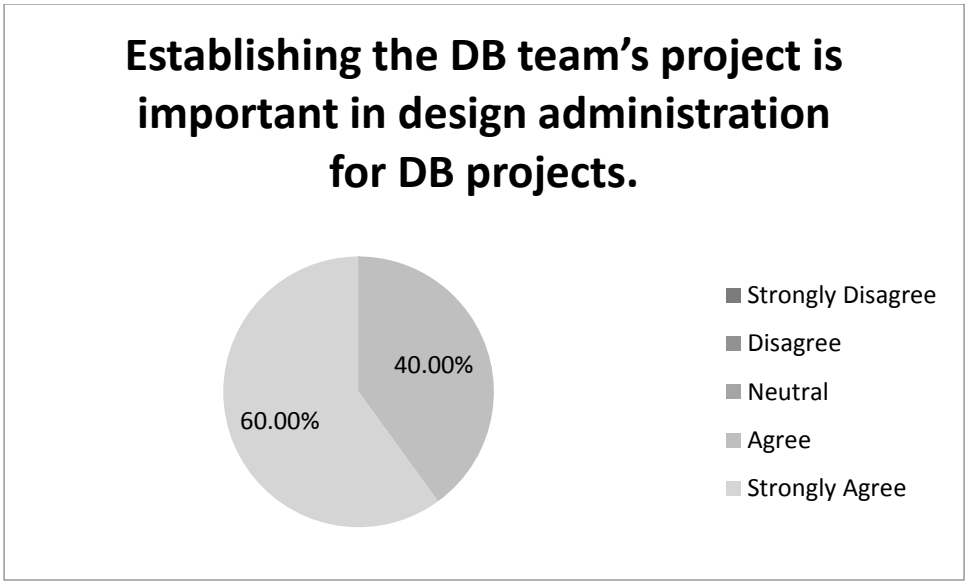

Figure 4.3 Survey Output with regard to Early Establishment of Design-Build Team Expectations

A successful DB project satisfies the owner's wants and needs within the cost and schedule criteria. Still, the owner is interested in more than the value for money in relation to the project development. The owner has distinct reasons for selecting the DB delivery method over other. The importance index explained in Chapter 3 was applied to the data to determine the reason DB is the preferred delivery method. See Table 4.4 for the factors that are considered most important in the selection process of the DB delivery method. It is important to note that early cost establishment rises to the top, along with reduced schedule. Cost and schedule make up two legs of the "three-legged stool" characterized by Gransberg et al. in 2006. It is previously believed that cost savings (value engineering) were a top contender for using the DB method over any other delivery method, like DBB (Tyler 2010). This data shows that cost certainty is more important.

Table 4.1 Importance Index for Design-Build Selection Factors

Importance Index Why is the DB Method selected?	
Early Cost Establishment	52.111
Reduced Schedule	45.444
Builder Involvement in the Design Process	40.986
Cost Savings	38.624
Single Entity Responsible for Design and Construction	30.650
Best Value Selection	24.407
Enhance Quality	21.369
Qualification-Based Selection of Both Designer and Builder	20.184
Innovation	10.729

The owner wants to know the costs associated with operation and maintenance over the project lifecycle (Doloi 2009). It is the design-builder's responsibility to balance the intricacies of the design and cost-effectiveness in the total project. This requires the design-builder to gain a complete understanding of the program and project parameters to deliver it per the owner's expectations. Table 4.2 portrays the interview responses regarding establishing owner expectations early in the design.

Table 4.2 Structured Interview Output with regard to Establishing Owner Expectations

Company	Position	Interview Output
The Beck Group, Dallas, TX	Project manager	"Lack of up-front coordination and pre-planning [can cause cost and time growth]. Not making sure you are on the same page with the client may cause rework [of the drawings]."
Trammell Crow Company, Dallas, TX	Principal	"Architects have to know what [the] expectations are. Set expectation of the design vision early. What's the business model behind it? Who are you competing with? What's the cost structure?"
The Beck Group, Dallas, TX	Project manager	"[Cost growth is primarily caused by] expanding or changing scope through owner changes. [Due to] lack of early programming with owner. Setting up early programming [with the owner establishes] expectations to diminish ambiguity. [You] can't stop an owner from changing stuff, but you have to try to mitigate cost increase and make the owner aware of impact on project."
JE Dunn, Dallas, TX	Project manager	"Not understanding the owner expectations before we set the budget [is the main cause of cost growth]. Use an outline specification to clarify the owner's expectations. Utilize target value design with questions like: What's driving the project? Things can be missed in the outline spec [ification], so communication regarding what the owner wants is important."
The Beck Group, Dallas, TX	Managing director	"The owner can be his own worst enemy. If the owner is driven by time and needs the project delivered by a certain date, we can help him get there with sacrifices, and he may not like that. Owners want the best of everything, but sometimes with the best of everything you can't meet something. There is a balance between cost, schedule, and quality."

Five out of five interviewees attributed cost growth to owner changes. Owner changes could be caused by initial poor communication between the DB team and owner or later scope changes to the design. Four out of five interviewees agreed having well-established owner expectations would mitigate "ambiguity in the design" and the risk of cost growth. The utilization of an "outline specification" or a clear "programme" as recommended by one interviewee is a valuable resource for ensuring the owner's expectations are understood.

Establishing owner expectations is the foundation for the design. This "practice" stems from ensuring effective communication. Reducing owner changes throughout the life of the design process will ultimately mitigate scope creep risk and the cost and time growth resulting from it.

Partnering Workshops

Industry professionals agree that a cohesive team is important in design-administration for DB projects (Minchin et al. 2014). Partnering can result in overall higher success rates for DB projects (Lam et al. 2009). Partnering efforts build trust and prevent adversarial relationships (Minchin et al. 2014). Partnering is not a new concept. The AIA presented a sample partnering charter to improve DB strategies in 2006. Partnering can be achieved through several tactics such as a formal partnering workshop or a post-award design charrette. According to Chan et al. (2004), partnering is a simple process between the contracting parties that ultimately helps minimize the risk of cost and schedule overruns. Ninety-seven percent of construction professionals agree with the literature in the belief that cost and time growth can be minimized by active collaboration between the designer and the contractor's preconstruction staff during the preparation of the design documents. See the pie graphs in Figure 4.4 and 4.5 for the breakdown of opinions of active collaboration as it applies to cost and time growth.

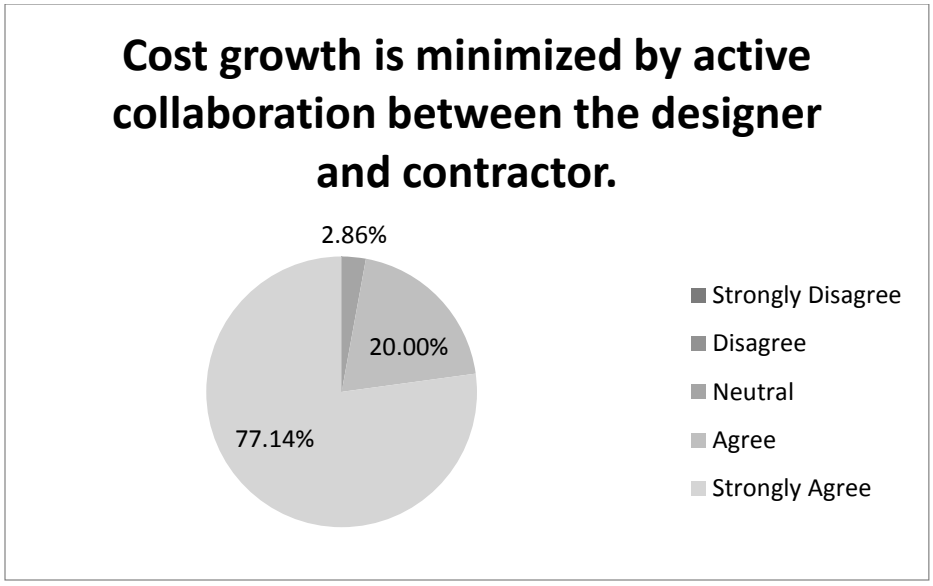

Figure 4.4 Survey Output with regard to Active Collaboration and Cost Growth

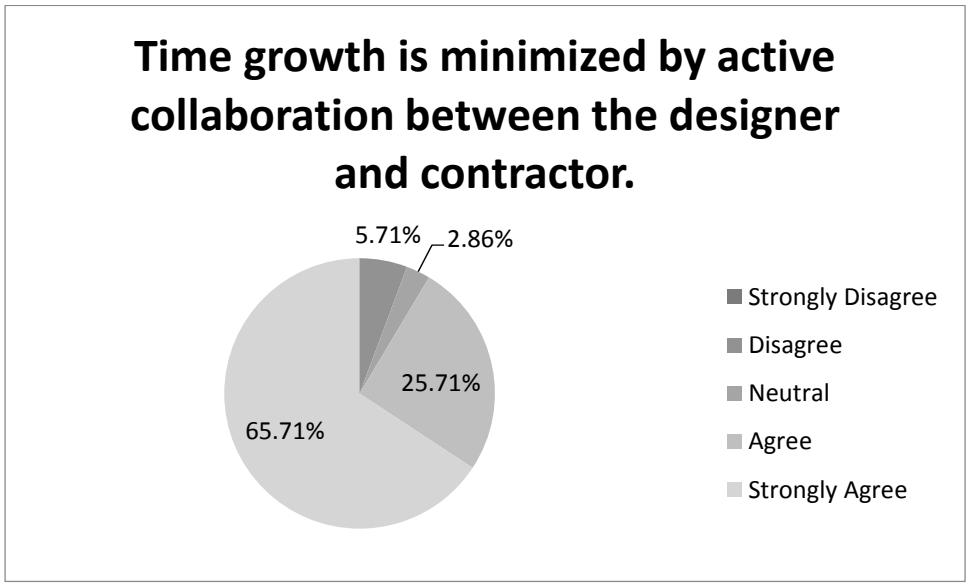

Figure 4.5 Survey Output with regard to Active Collaboration and Time Growth

A construction project's objectives can be best achieved through "a collaboration that promotes and facilitates strategic planning, design, construction, and commissioning of the project" (Gatti et al. 2014). The survey yielded a 4.40 average weighted score of agreement to

the statement: “a formal partnering workshop adds value to the relationships between members of the design-build team and the owner’s team.” Table 4.3 contains information derived from the structured interviews with regard to partnering.

Table 4.3 Structured Interview Output with regard to Partnering

Company	Position	Interview Output
JE Dunn, Dallas, TX	Project manager	“A partnering session is always good start. There is often an inherent [disconnect] between construction manager and designer. [The partnering session will help] set expectations. It’s better to build a personal relationship, than a business relationship (a relationship outside of the confines of the project). Emphasize what is important to [the designer] and learn it. [It] will let you help [the designer] accomplish its goal. And that helps it to help you.”
The Beck Group, Dallas, TX	Managing director	“Have a teaming collaboration with internal team so that we understand each other. If the team doesn’t feel aligned, it will show up later in project.”
The Beck Group, Dallas, TX	Project manager	“Collaborative work [mitigates] rework.”
The Beck Group, Dallas, TX	Project manager	“The biggest thing [in DB] is cohesion of team and trust.”

“Cohesion of team and trust” is an important platform for a successful DB project according to one interviewee (Table 4.1). The survey yields a 4.76 average weighted score regarding the statement: “a cohesive team is important in design administration for design-build projects.” One can see from Table 4.1 that the notion of forming cohesive teams is emphasized with one interviewee indicating that holding a formal partnering session is a “good start” to forming a “personal” relationship that is necessary. Wilking (2006) agrees with this way of

thinking in that "camaraderie developed outside the workplace can be carried over into a business relationship." This is a somewhat different approach in an industry whose professional relationships are governed by contracts (Forgues and Koskela 2008). It may indicate that the ability to control scope creep during design is strongly related to the ease with which the contractor and designer are able to communicate. The interviewees confirm the importance of establishing a healthy relationship between the designer and contractor to ensure the success of the DB project. Partnering is a tool that aids in the development of a long-term relationship between the team members (Chan et al. 2001). This relationship can be used in project design to form a healthy level of communication, which is important for ensuring the success of the design administration process.

Timely and Accurate Production of Design Documents

There are two issues that should consistently be addressed in the case of design; first, the provision of accurate, fully coordinated, complete information and, second, the timely provision of information (Gray and Hughes 2000). Johansen and Carson (2003) consider the first issue to be the responsibility of the lead designer and the second to be the responsibility of the management. Koskela et al. (1997) concluded that design planning is substitutes by chaos and improvisation. While the industry is in agreement that a more complete set of design documents results in a lower scope creep risk, increasing the design time is not always valuable. Only about half of the survey respondents agreed that an increase in design time decreased the risk of cost growth, time growth, and scope creep (See Figures 4.6-4.8). Frederickson (1998) speculates that no more design should be done than what is absolutely necessary, although enough information

needs to be provided to clearly depict the vision for the project. Still, the survey yielded an average weighted score of 3.91 regarding the statement: “scope creep risk increases as the level of specific design information in the RFP decreases.” This begs the question: what is considered the appropriate level of design to accurately price a set of drawings?

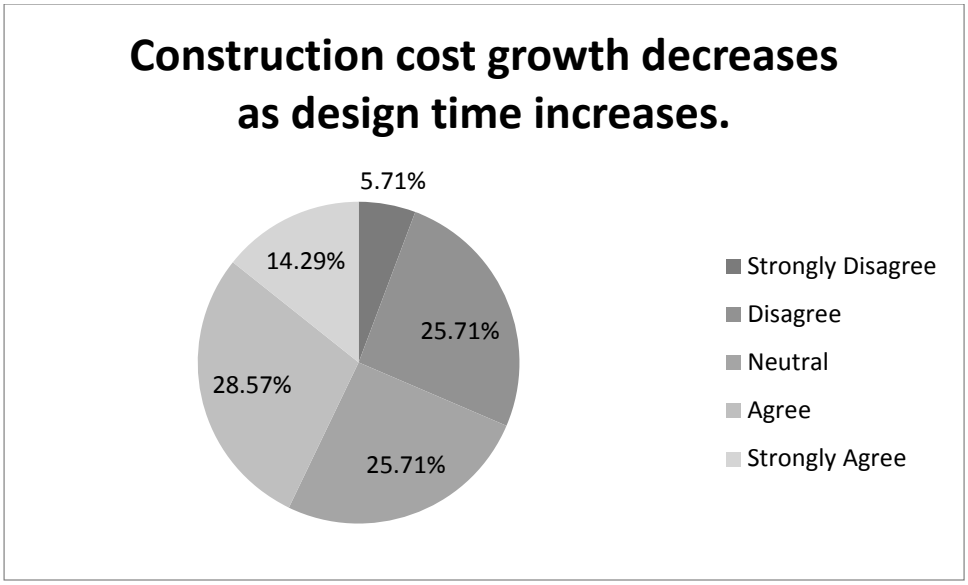

Figure 4.6 Survey Output with regard to Design Time as it relates to Cost Growth

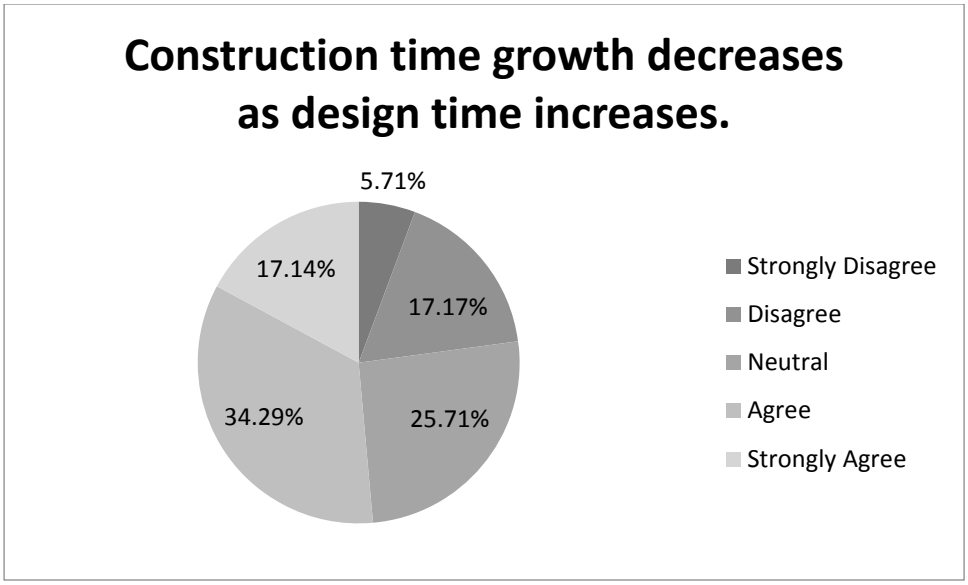

Figure 4.7 Survey Output with regard to Design Time as it relates to Time Growth

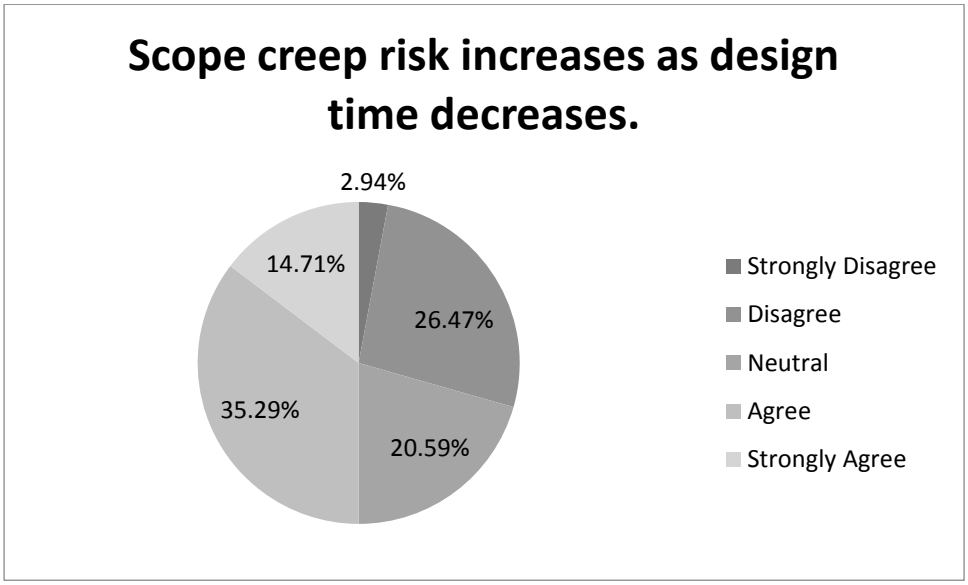

Figure 4.8 Survey Output with regard to Design Time as it relates to Scope Creep

Interviews with industry professionals showed that four out of five agreed the best way to ensure a timely production of design documents is to motivate by focusing on accountability.

While some believe designers are motivated by money or prestige (Design Management Guide 2011), case studies in the Dallas Fort Worth region show liability to be the most effective motivator. Refer to Table 4.4 as the interviewees discuss ensuring the timely and accurate documents from the designer.

Table 4.4 Structured Interview Output with regard to Accurate Design Documents

Company	Position	Interview Output
The Beck Group, Dallas, TX	Project manager	"To ensure continuum of design, get owner decisions made to not miss design target dates. Make sure people are doing their jobs"
Trammell Crow Company, Dallas, TX	Principal	"The more time you give them (architects) to design, the more bad things happen. Time isn't used productively because it gives the designer more time to make decisions that aren't value based. [You must] communicate throughout the design and assess what they are drawing. Hold the designer accountable. Give the designer an understanding of their role in context to the overall team and delivering their expectations in association with the business model, then follow through from an accountability perspective. You need to afford the designer an appropriate amount of time to do job, but they need to be accountable to do it."

Five out of five interviewees believe increased design time does not increase the quality of documents. More design times allows for "unproductiveness" according to one interviewee. From an owner's perspective, extra time allows for decisions to be made that are not "value-based." There is a balance in holding the designer accountable for the design while "affording the designer and appropriate amount of time to complete the job."

Accurate and timely production of the design documents is considerable factor in design administration success. While increased design time may not be beneficial, there are other

factors that enable the continuum of productive design. Those factors were revealed in the research and are discussed in the sections to follow.

Early contractor involvement

By putting the designers and contractors on the same team, numerous benefits are reaped for design administration in DB projects. Early contractor involvement allows for feedback on constructability issues, market conditions, material prices, and more. According to Koch et al. (2010), when a constructability review is paired with a cost engineering review, the design is less susceptible to cost and time growth due to errors and omissions. Eighty-seven percent of construction professionals agree cost and time growth can be minimized by the early contractor budget input to the designer regarding contract proposal price constraints. See the pie graphs in Figure 4.9 and 4.10 for a depiction of survey responses regarding early contractor involvement as it applies to cost and time growth.

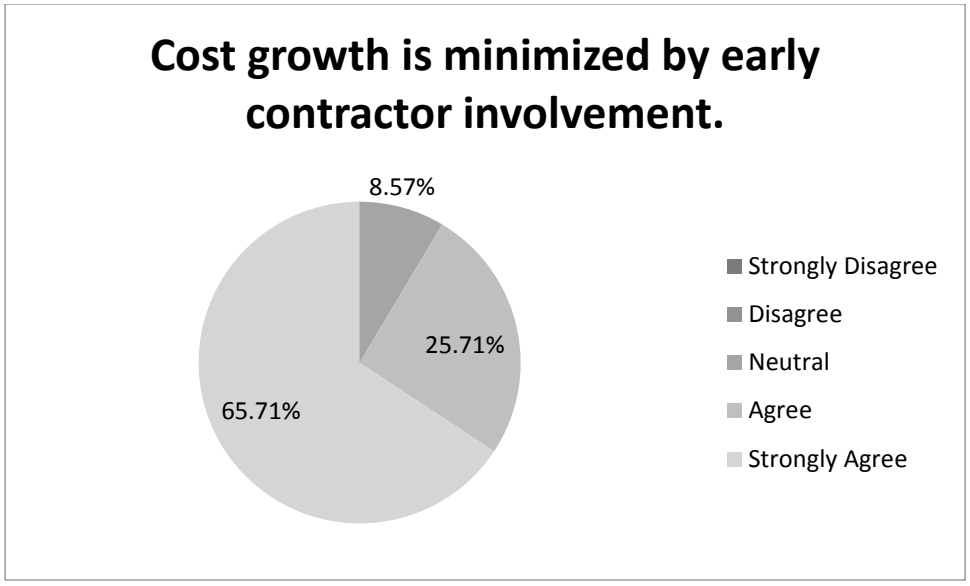

Figure 4.9 Survey Output with regard to Early Contractor Involvement and Cost Growth

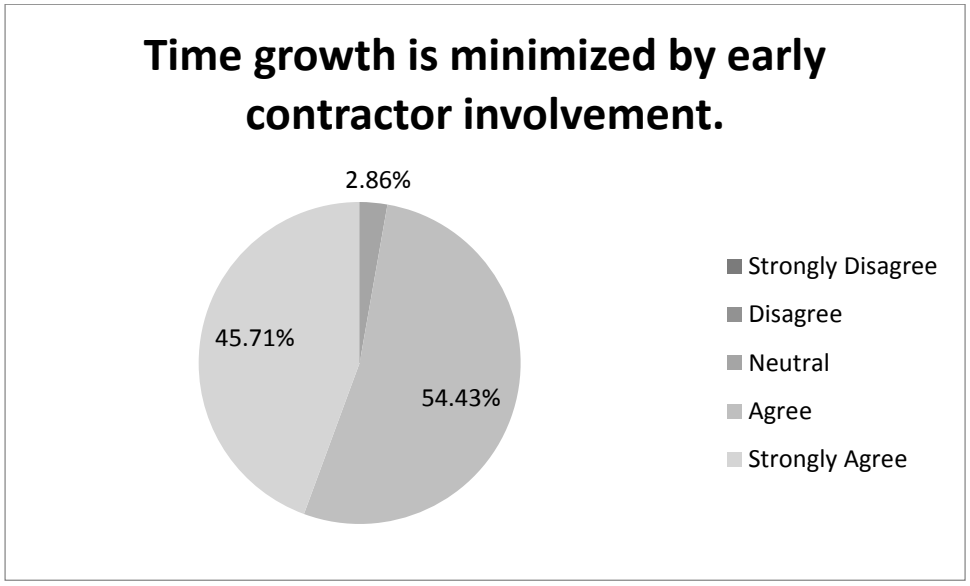

Figure 4.10 Survey Output with regard to Early Contractor Involvement and Time Growth

Early contractor involvement allows the team members to clarify roles and responsibilities. Early in team development, the designer and contractor can resolve the degree to

which the construction documents need to be prepared (Frederickson 1998). Table 4.5 organizes the interviews as they relate to early contractor involvement.

Table 4.5 Structured Interview Output with regard to Early Contractor Involvement

Company	Position	Interview Output
The Beck Group, Dallas, TX	Project manager	"Getting input from the contractor allows you to get real values and time frames for projects. [Cost and time growth can be minimized by] early identification of market conditions and long-lead materials and equipment. Getting subcontractors involved early is important too."
Trammell Crow Company, Dallas, TX	Principal	"[Cost growth is primarily caused by] lack of coordination and communication as it relates to constructability. There should be on-going dialogue between the design team and construction team. No matter how much technology improves, you can never replace human interface. You have to have people talk to each other."
The Beck Group, Dallas, TX	Project manager	"[Cost growth can be] mitigated by having very well defined cost per square foot (unit prices) and allowances then having the designer work towards those and collaborating with the precon[struction] group. Communication [between the designer and contractor] is very important."
The Beck Group, Dallas, TX	Managing director	"Get involved early in the design process. Establish common expectations and goals, and get into a detailed discussion what is needed to help architect be more efficient. Also, early purchasing prevents time growth. Committing early to subs helps too."

One interviewee allows early contractor involvement as a means to obtain "real values and time frames for a project." This type of up-front information provided by contractor factors in the mitigation of cost and time growth. The contractors' preconstruction group and other trade consultants offer an insight into material, equipment, and labor costs designers may not have access to. The "coordination and communication" must be on-going between the designer and

contractor to ensure the design is on target. The interviewees agree at multiple points that early contractor involvement and the coordination with the design team is a factor in the mitigation of cost and time growth. The feedback given through contractor involvement also allows for accurate production of the design documents.

Design Reviews

Literature has found design reviews to be beneficial throughout the design process as they often improve the quality of design before the final submission. (Minchin et al. 2014) Design reviews aid in the identification of constructability issues while also ensuring the design intent and program goals are being met. Eighty-seven percent of survey respondents agree a periodic informal (over-the-shoulder) design reviews are important for design administration for DB projects. Refer to Figure 4.11 for a pie chart relating to the survey respondents view of over-the-shoulder design reviews.

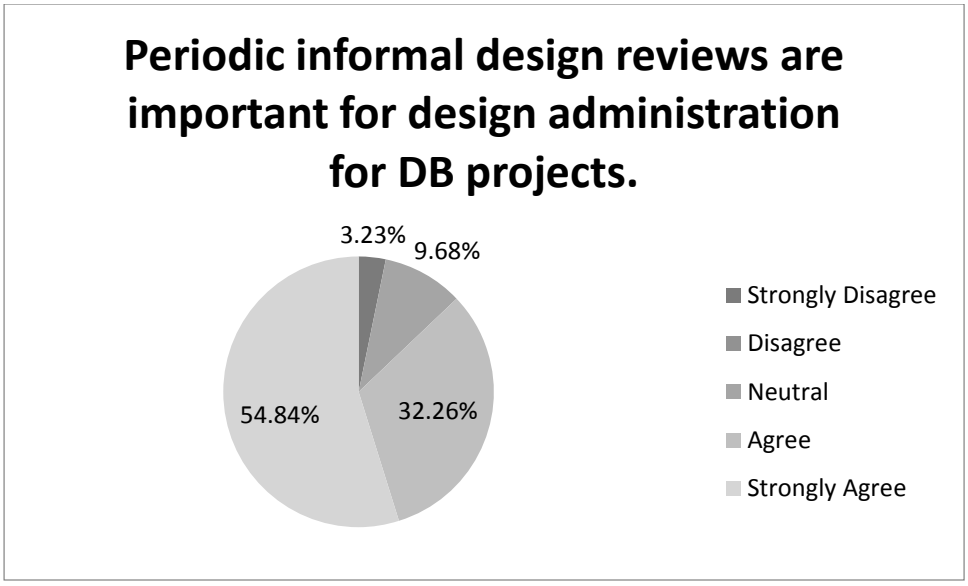

Figure 4.11 Survey Output with regard to Informal Design Reviews as it relates to Design Administration

Most survey respondents agree that scope creep risk increases as the number of contractor or owner design reviews decreases (Figure 4.12 and 4.13). Design reviews are a means of keeping the designer accountable in producing the project to the owner expectations, in turn, keeping the price in check. Design reviews are crucial to the design administration process (Koch et al. 2010).

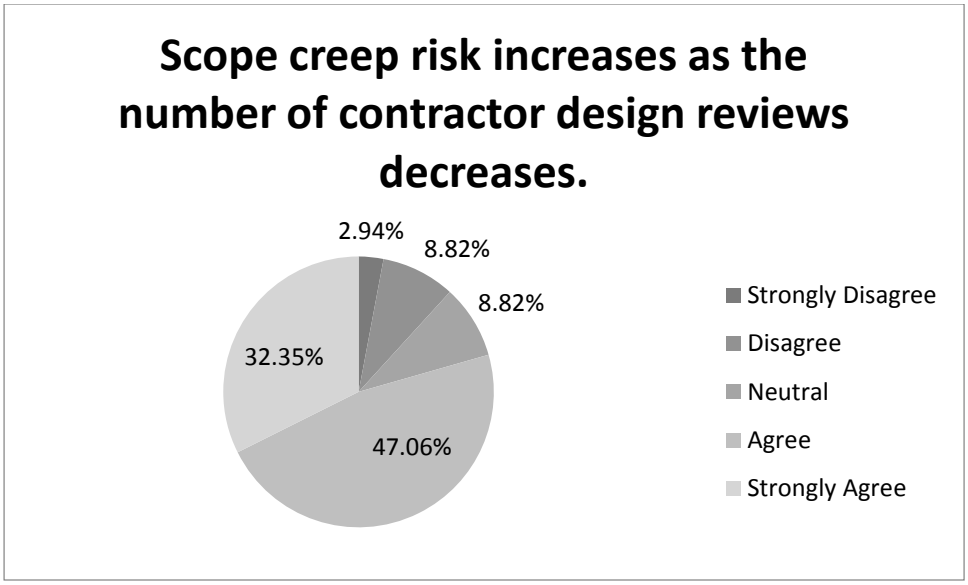

Figure 4.12 Survey Output with regard to Scope Creep as it relates to Contractor Design Reviews

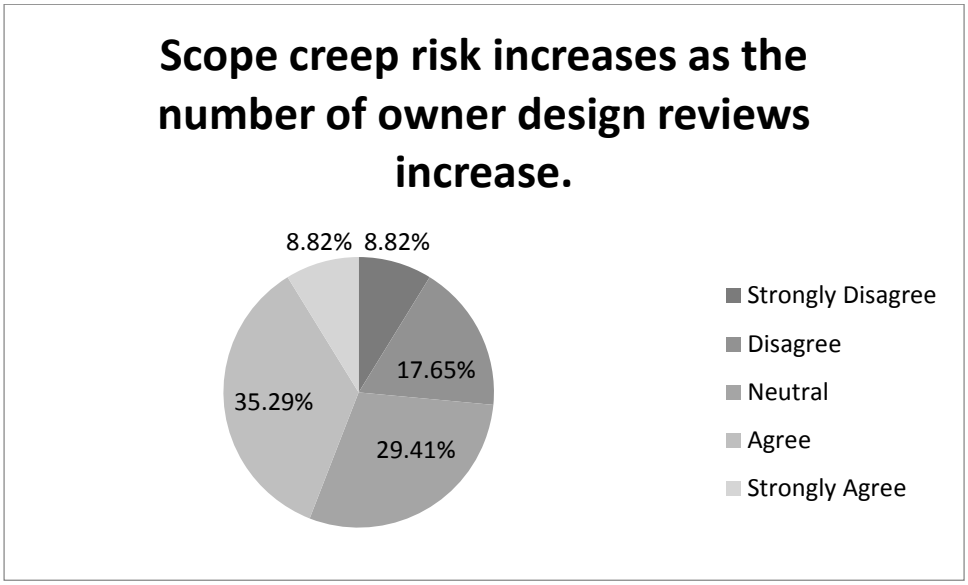

Figure 4.13 Survey Output with regard to Scope Creep as it relates to Owner Design Reviews

Design reviews help “flush out inefficiencies and oversights” according to one interviewee. By maintaining communication thorough the design review process, you can “keep

the designer on task." The design reviews ensure that owner expectations are being met. The design reviews also allow for contractor input on constructability regarding building systems, assemblies, and details. Refer to Table 4.6 for the interviewees' opinions of design reviews.

Table 4.6 Structured Interview Output with regard to Design Reviews

Company	Position	Interview Output
The Beck Group, Dallas, TX	Project manager	"If Beck is working with a third-party architect, we have a policy to review each design trade (structural, MEP, architectural) with a sub consultant to flush out any inefficiencies or oversights. [It is] good to have two sets of eyes. Based on pace and size of project, usually at each of each design phase."
JE Dunn, Dallas, TX	Project manager	"Design reviews helps the designer stay on target. [You have to] keep a healthy level of communication with design team to keep designer on task."

The survey concluded an average weighted score of 4.26 regarding the statement: "construction cost growth can be minimized by timely review and approval by the owner of design documents". There is an undistinguished level of frequency of design reviews that is standard. Essentially, there is no one size fits all as design reviews are dependent upon the size and complexity of the project. Constructability reviews can be incorporated into the design administration process "by defining parallel constructability phases, such as constructability in conceptual design, schematic design, or construction document quality." (Koch et al. 2010). Minchin et al. (2014) report created a chart of recommended design reviews during design development (shown in Figure 4.2).

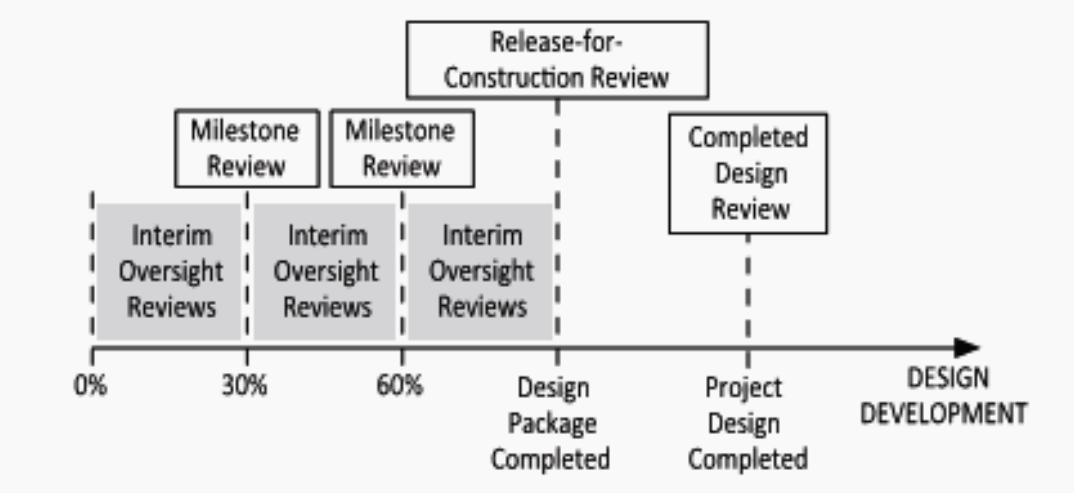

Figure 4.14 Design Reviews during Design Development (Minchin et al. 2014)

The above figure illustrates the importance of design milestone reviews; however, the survey showed the necessity of having design reviews more often than every milestone. The survey confirmed most respondents believed different design reviews should occur bi-weekly to monthly. Table 4.7 shows the survey respondents' perspective on the necessary frequency of different types of design reviews. Nonetheless, four out of five interviewees agreed design reviews should occur at the end of each design phase which is in agreement with the literature.

Table 4.7 Survey Responses in relation to Necessary Frequency of Design Reviews in Design-Build Projects

	Never	Weekly	Bi-Weekly	Monthly	End of Design Phase
Building code analysis and reviews	0.00%	6.90%	17.24%	34.48%	41.38%
Design peer reviews	0.00%	0.00%	34.48%	24.14%	41.38%
Design standard checks	0.00%	6.90%	41.38%	27.59%	24.14%
Material/equipment supplier involvement in the design review process	3.45%	13.79%	20.69%	37.93%	24.14%
Owner criteria compliance checks	0.00%	24.14%	20.69%	27.59%	27.59%
Constructability reviews	0.00%	17.24%	34.48%	27.59%	20.69%
Trade sub consultant involvement in the design review process	0.00%	27.59%	24.14%	31.03%	17.24%
Informal/over-the-shoulder reviews of design in progress with the owner	0.00%	20.69%	51.72%	20.69%	6.90%
Informal/over-the-shoulder reviews of design in progress with the contractor	0.00%	37.93%	41.38%	17.24%	3.45%

Regardless of frequency, a majority of survey respondents agree cost and time growth can be minimized by timely review of the design documents by the owner. This places the ball back in the owner's court. If changes to the documents need to be made, a decision from the owner is crucial to for the continuum of design.

Design manager

The contractor is often considered the most appropriate choice to play the role of a design manager in DB projects (Chan et al. 2005). The contractor has the knowledge to control the design information and ensure it meets the owner's objectives. The use of a design manager is thought to improve the quality of the final design documents. A study conducted by Engineers Australia (2005) found a decline in the quality of design documentation due to design administration failures, including the "absence of an experienced, client-approved design manager." Most survey respondents also agree that appointing a design manager improves the quality of the final design documents. See the pie graphs in Figures 15-18 to view the breakdown of survey responses regarding the utilization of a design manager.

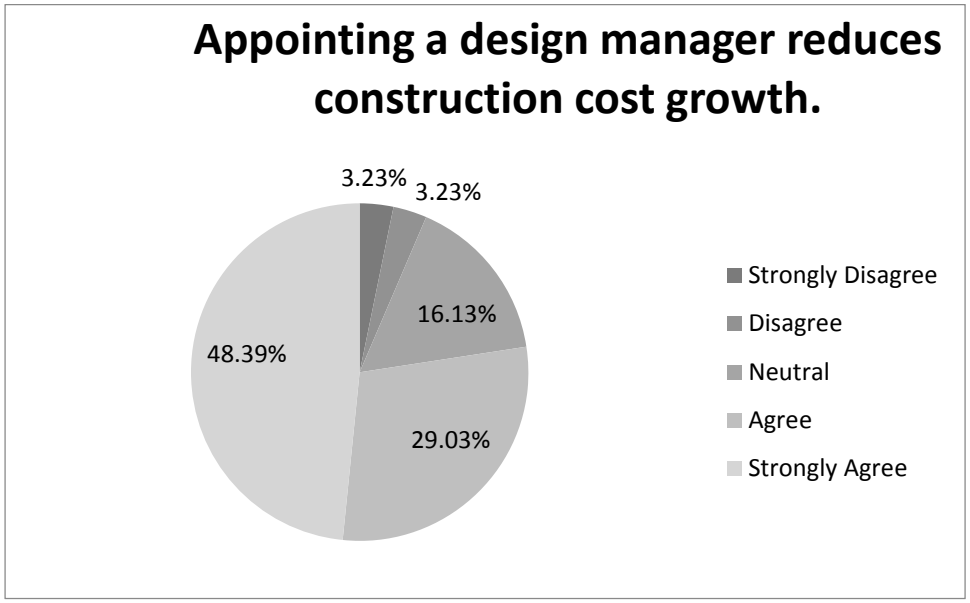

Figure 4.15 Survey Output with regard to an Appointed Design Manager and Cost Growth

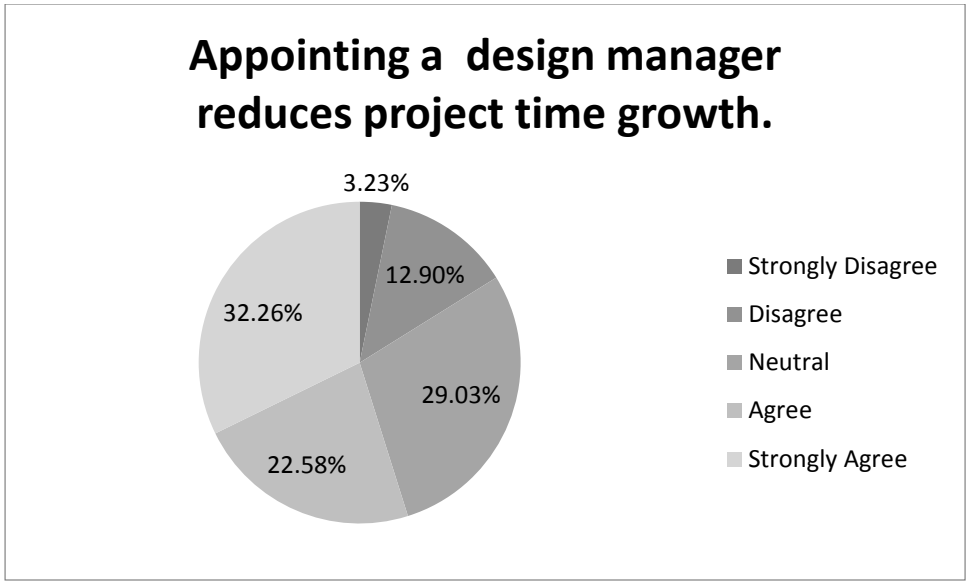

Figure 4.16 Survey Output with regard to an Appointed Design Manager and Time Growth

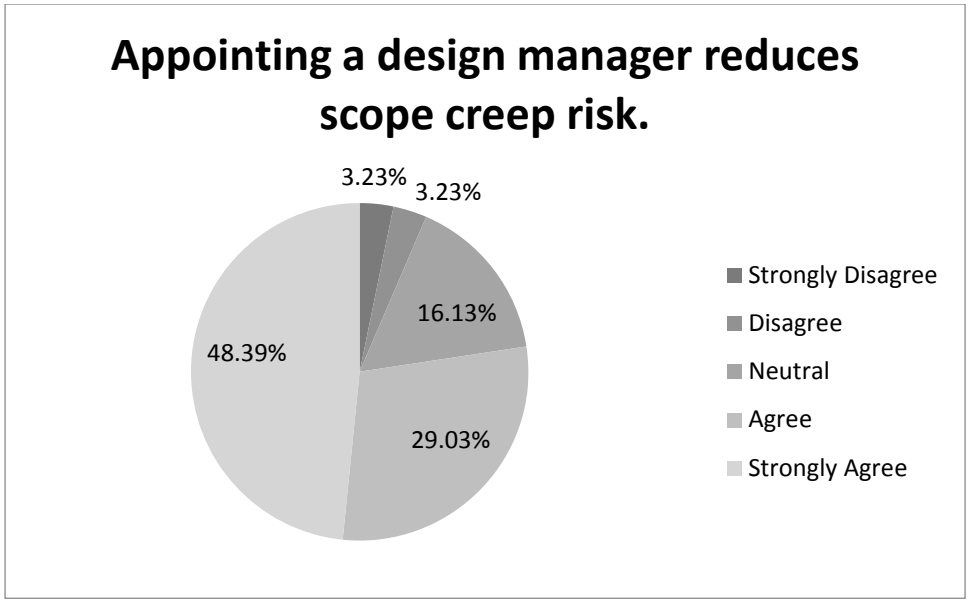

Figure 4.17 Survey Output with regard to an Appointed Design Manager and Scope Creep

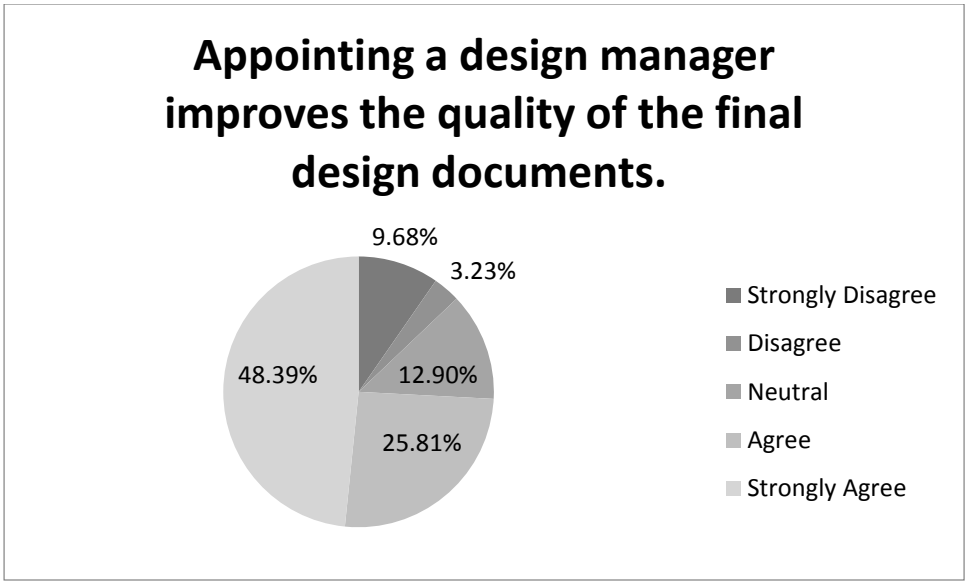

Figure 4.18 Survey Output with regard to an Appointed Design Manager and Design Quality

The Beck Group employs a similar position as the design manager in their company known as the integrate project leader (IPL). The Beck Group assigns an IPL to every DB project to ensure the flow of design. Four of the five interviewees had experience working with a design manager and explained the pros in appointing a design manager on a DB project. See Table 4. 8 for the interviewees input on a design manager.

Table 4.8 Structured Interview Output with regard to Design Managers

Company	Position	Interview Output
The Beck Group, Dallas, TX	Project manager	"The IPL makes sure the process keeps moving and clears any road blocks. He/she is the ultimate decision maker. The IPL is like a design manager. He/she is involved in the design, but he/she is not actually working on drawings. We need someone that is not nose down in documents to see it from a higher level to analyze documents from a different perspective."
Trammell Crow Company, Dallas, TX	Principal	"[Scope creep can be] mitigated by a single-source contact. Regardless of delivery model, there needs to be clear chain of command and hierarchy of communication. You can't have 50 people talking to each other."
The Beck Group, Dallas, TX	Project manager	"An ultimate responsible person to make decisions that will benefit the project and the client in terms of cost, schedule, and quality."

Whether the role is called a design manager or an IPL, three out of five interviewees agree the role of a single source of contact for design administration is vital. A design manager "keeps the design process moving" according to one interviewee. The design manager is able to oversee the design and make important decisions. The interviewees agree with literature and survey respondents that a design manager is a factor that will "benefit the project and client in terms of cost, schedule, and quality."

Building Information Modeling

BIM has been long been considered a breakthrough in construction. The higher the level of integration of BIM early in the design stages, the greater the opportunities for benefits of BIM. Interestingly, the survey found more than half the respondents on the fence about the value of BIM (Refer to Figures 19-22).

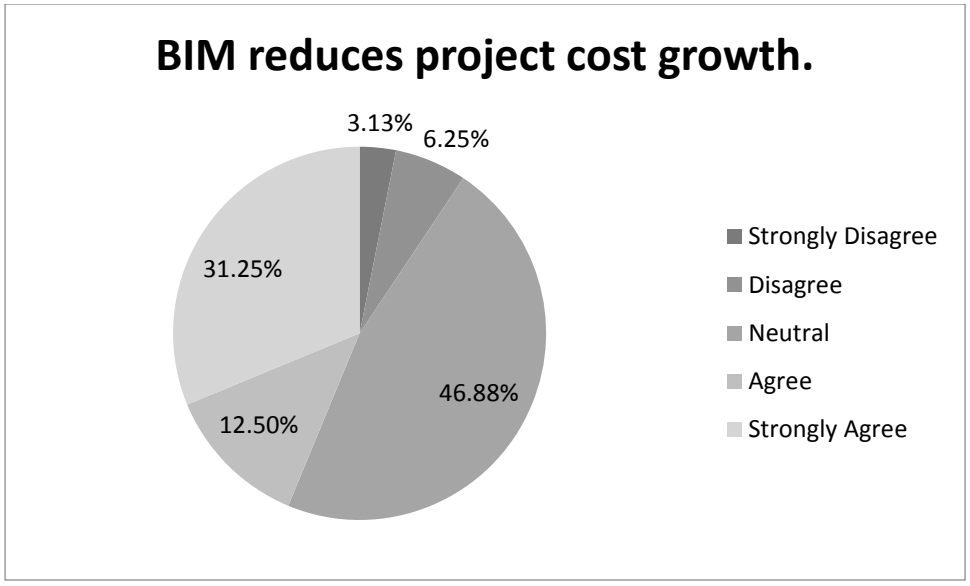

Figure 4.19 Survey Output with regard to BIM as it relates to Cost Growth

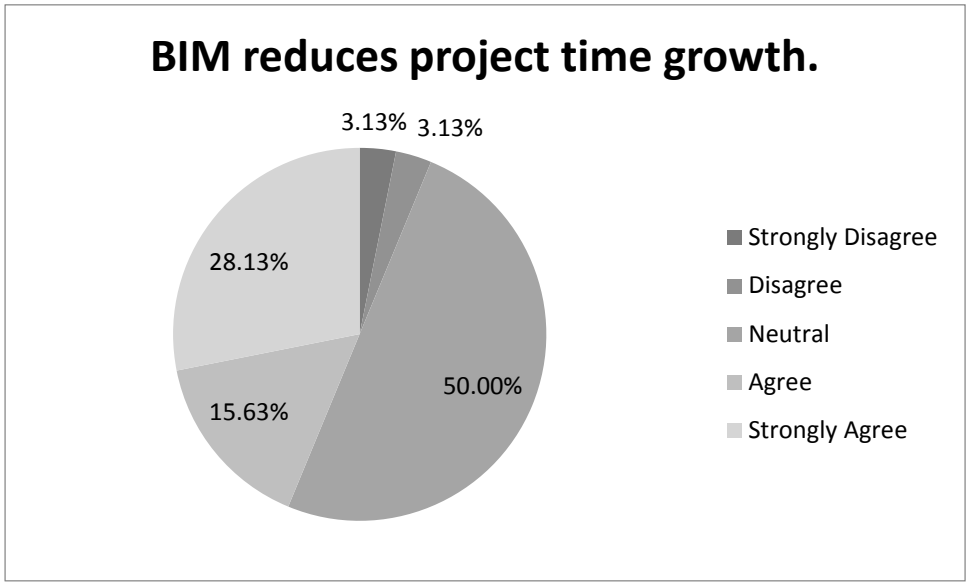

Figure 4.20 Survey Output with regard to BIM as it relates to Time Growth

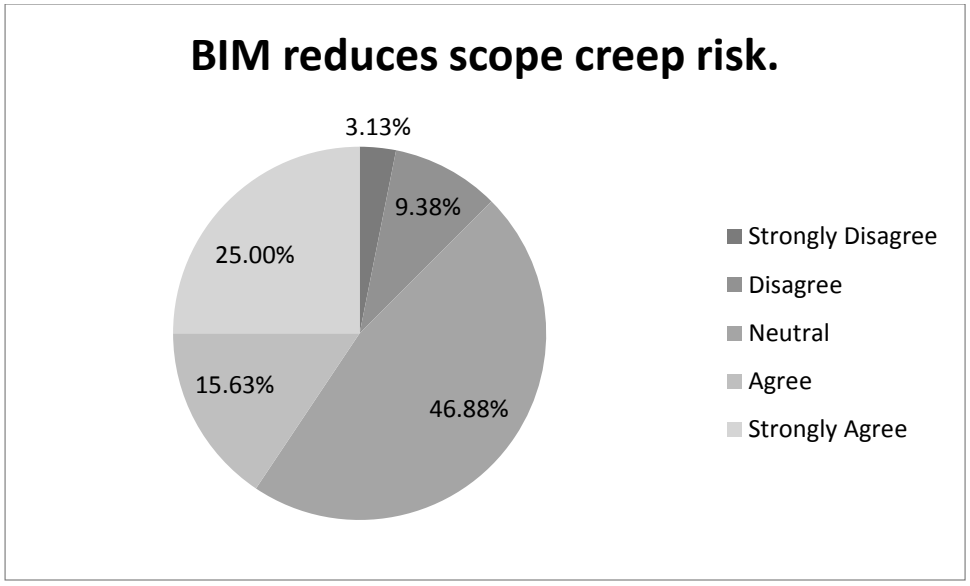

Figure 4.21 Survey Output with regard to BIM as it relates to Scope Creep

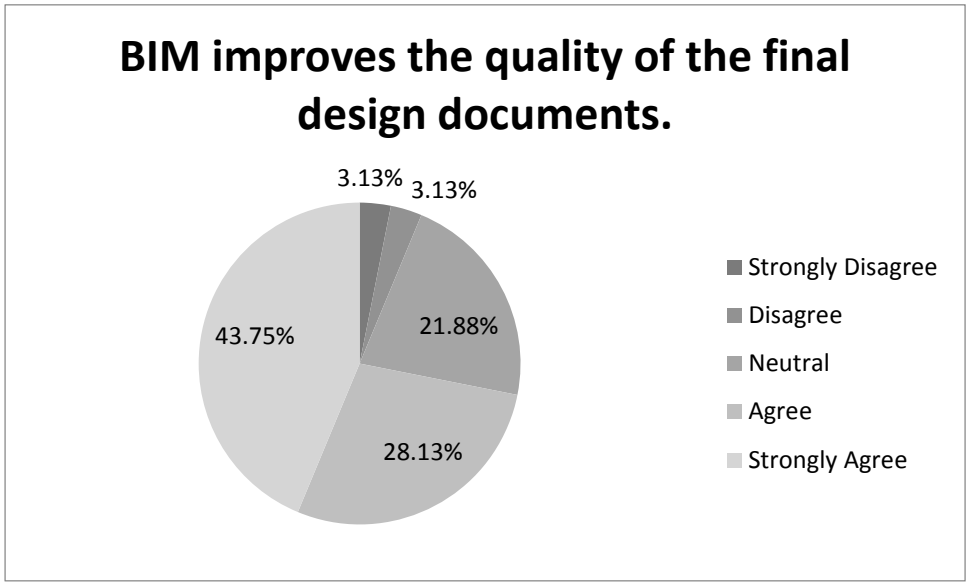

Figure 4.22 Survey Output with regard to BIM as it relates to Design Quality

While BIM excels in coordination between trades, especially on the MEP side, one interviewee claims it is extremely time consuming. The interview revealed BIM seems to be the cause for the decrease in quality of drawings over the past few years. Refer to Table 4.9 for an in depth opinion on the use of BIM for design documents today.

Table 4.9 Structured Interview Output with regard to BIM

Company	Position	Interview Output
The Beck Group, Dallas, TX	Managing director	"Not all architects put out same level of drawings. BIM has changed a lot of things and make things more set. For instance, before BIM, we could easily draft a detail requested by the contractor. But with BIM, we have to build the whole model before being able to extract details. Developing drawings is different. It blends into levels of 30%, 60%, 90%. Architects are producing less because BIM is requiring them to put information where they don't have time to."

The thoughts from this interview tie back to the topic of timely and accurate production of design documents as it relates to design administration. An interesting point is the decline of timely and accurate documents could be affected by the rise in BIM use. This is a topic that may need further research.

Other Points

The research scaled over many topics as it related to design administration. Some topics intersected in agreement with the literature, survey, and interviews, while others did not. Still,

there are some conclusions in the survey responses and also the interviews that are important to note.

- Co-location - One interviewee discussed the importance of placing the design team and preconstruction team within the same vicinity to facilitate communication and coordination. Refer to Table 4.10 as the interview discusses the importance of collocation as it is incorporated in the company policy.

Table 4.10 Structured Interview Output with regard to Co-location

Company	Position	Interview Output
The Beck Group, Dallas, TX	Managing director	"Our company has evolved a process where we must be co-located, a construction manager needs to be involved from the beginning and working with the design. – integrated project leader (he makes sure schedule is being met on design side). The construction manager helps designer push out design by suggesting subs to produce details (i.e. curtain wall sub will have shop drawings be final CD drawings). Co-location offices the design leader and construction manager next to each other on a project which creates an immediate answer to all parties back and forth. "

- Organized communication - The Design Management Guide advises a single strategy to manage information in design administration. Survey respondents placed a large amount of importance on the use of organized communication as it applies to the success of DB projects. Refer to the pie charts in Figures 23 and 24 for a breakdown of survey responses regarding communication tools. There are different methods of standardized

communication. For instance, Koch et al. (2010) suggests a drawing numbering system, but there are other tools that could be implemented for the design administration process.

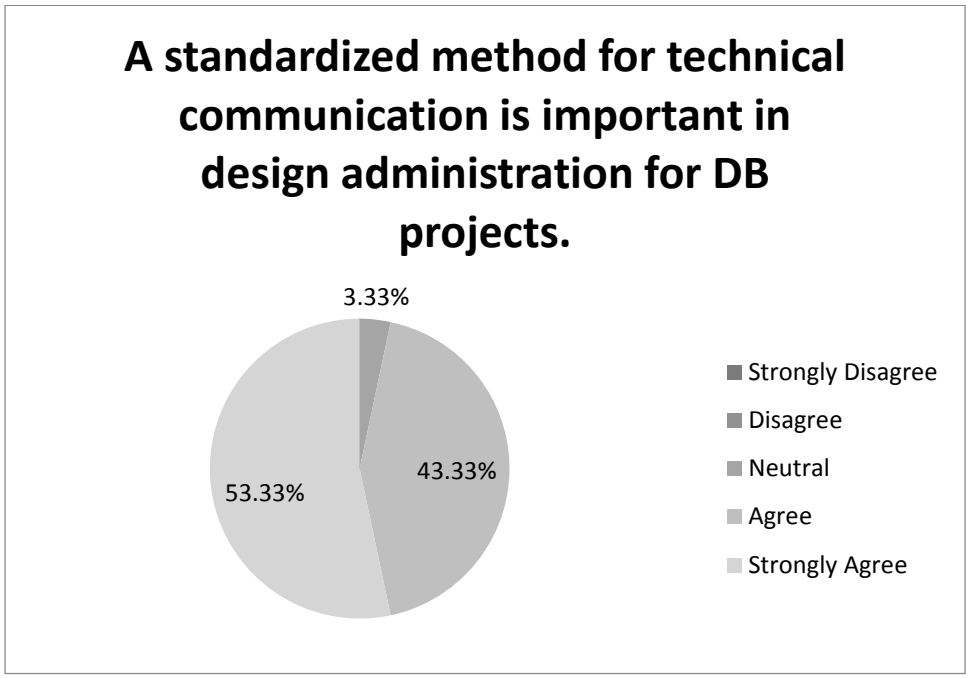

Figure 4.23 Survey Output with regard to Standardized Communication in Design-Build projects

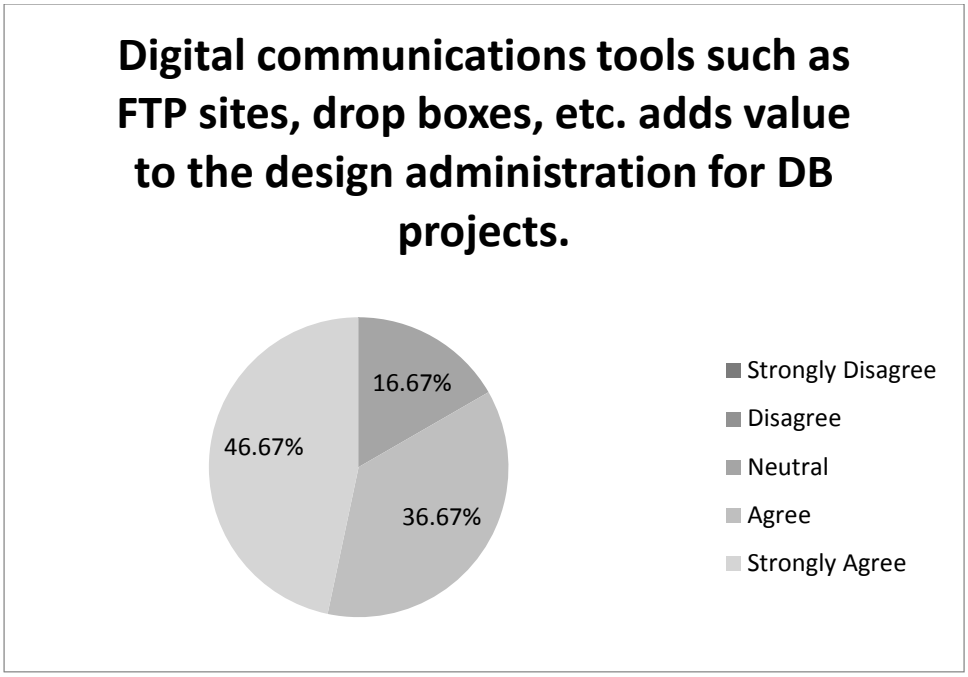

Figure 4.24 Survey Output with regard to Digital Communication in Design-Build projects

- Dispute/Disagreement Escalation Ladder - While it is ideal for partnerships to run smoothly, disagreements are inevitable. The use of a dispute/disagreement ladder may be a useful in design administration. The respondents agree with an average weighted score of 4.10 that a dispute/disagreement ladder between the owner and DB team adds value to the design administration process. The respondents also agree with an average weighted score of 4.10 that an internal dispute/disagreement ladder for the DB team is an important tool in the design administration process.

CHAPTER 5

CONCLUSIONS AND LIMITATIONS

This section provides an overview of the conclusions and limitations of the research conducted in relation to design administration in DB projects. The purpose of the following research is to provide a framework of best practices in design administration to effectively manage the risk of scope creep, and therefore cost and time growth, in DB projects.

Conclusions

The research found conformity between the literature and survey responses on several levels regarding the factors that affect cost and time growth and scope creep in design administration. The interviews were employed as a means of validation for the previous two instruments of research. The following were the conclusions drawn from the research:

- The research concluded that misunderstanding the owner expectations initially in the project is a large cause of scope creep. Well-established owner expectations at the initial stages of design aids in the mitigation of cost and time growth risk and any rework of the design.
- The research concluded a partnering workshop or teaming exercise between the designer and contractor proves to be beneficial for building a trusting relationship. Forming

"camaraderie" outside the workplace will carry over into the business world and found a lasting relationship between partnerships.

- The research concluded that the timely and accurate production of design documents reduces scope creep risk. Accountability is considered the best motivational tool to ensure timely and accurate production of design documents as discovered through the structured interview process.
- The research concluded that early contractor and sub consultant involvement in the design process is important for establishing real values and schedules which ultimately reduces the risk of cost and time growth.
- The research concluded that design reviews are important for vetting out constructability issues while also ensuring the designer stays on task. The research did not conclude the most productive frequency for design reviews through the design administration process.
- The research concluded that it is best to have a single source of contact through a design manager which is important for reducing cost and time growth.
- The research determined a disconnect in the use of BIM in design administration as it appears to increase the timely delivery of design documents.

Limitations

The study was conducted with design administration in commercial DB projects in mind. The survey sample was limited to contractors, designers, design-builders, owners, and

subcontractors in the Dallas / Fort Worth area of Texas. As such, it results cannot be immediately generalized to the universe of DB projects. While the research could be applied to a similar scope of projects, there are still regional issues within DB design administration that need further analysis.

No attempt was made to apply the framework to DB projects other than commercial buildings as it was beyond the scope of the research. Again, the framework was intended to be generic and may provide a starting point for developing a similar framework for non-commercial buildings and heavy civil/industrial DB projects.

Framework

From the above research, a framework for design administration was developed to illustrate the points of conclusion. See Figure 5.1 for a flowchart highlight the tools derived from the research that ensure minimal scope creep in design administration in DB projects. For instance, “establishing owner expectations” intersected at all three research instruments; therefore, proving its significance in design administration. Hosting a successful owner expectations meeting before the design begins will set the foundation for the design administration and thereby reduce scope creep risks later. All of the ‘best practices” shown in the flow chart allow for successful design administration. The research concluded that by incorporating these “workshops” and “meetings” into the design administration process, the risk of scope creep is greatly reduced.

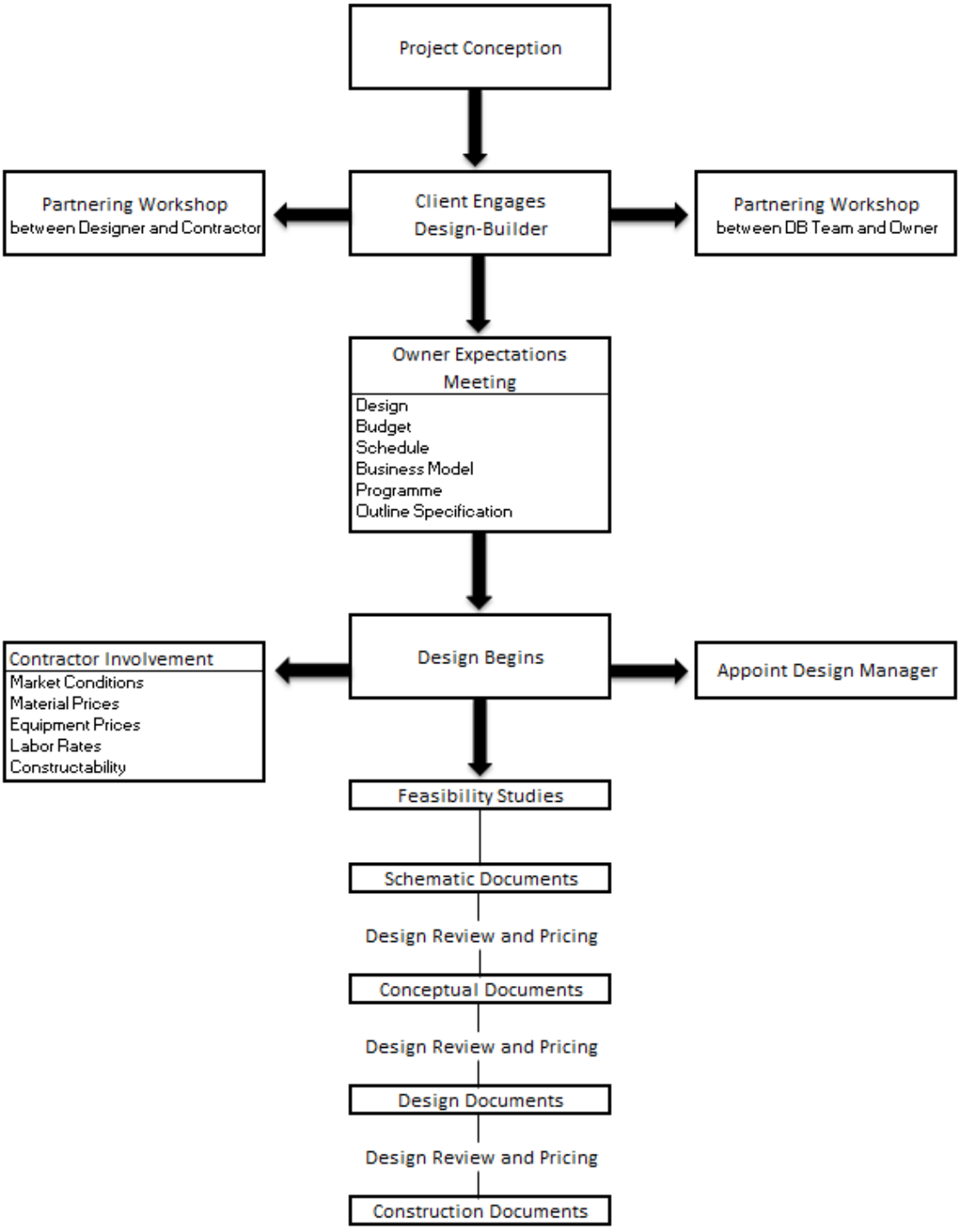

Figure 5.1 Design Administration Framework

CHAPTER 6

CONTRIBUTIONS AND RECOMMENDATIONS

Contributions

The study of literature on previous research in the field of design administration in DB projects illustrated important design administration tools for reducing cost and time growth and scope creep in DB projects. The above research emphasizes relationships, trust, communication and the flow of information in design administration. While the research concluded similar "best practices" as found in some of the literature thereby reinforcing the conclusions in the literature, many other important positions on the topic of design administration were reached.

- Communicating and understanding the owner's expectations in the initial stages of the design is crucial for reducing the risk of design changes and scope creep in the future. This is best accomplished by having a meeting with the owner to establish the expectations and project programme early before the design advances too far.

Recommendations for Future Research

With the previous methodology and data in mind, the following are suggested for further research:

- The research included a survey sample of respondents in the Dallas / Fort Worth area. It is recommended that future survey extend across the United States to encompass a larger pool of DB opinions of best practices in design administration.
- The research included a wide variety of factors that make design administration successful. It is recommended to conduct more in depth research on the individual factors to determine what makes them a useful tool in design administration. For instance, "establishing owner expectations" concluded to reduce the risk of scope creep. It would be valuable to determine what specific items need to be effectively communicated to ensure the owner's needs and wants are met throughout the design process. A meeting agenda could possibly be developed from the research results.
- The research concluded the effectiveness of design reviews to minimize cost and time growth in the design administration process. Still, the research is inconclusive of the productive amount of design reviews necessary in design administration. It is recommended to complete research that may help set a standard for design review frequency in design administration.
- The research concluded a divide in the value of BIM in design; whereas previous notions agreed BIM to be an efficient tool in the design process. It is recommended to conduct future research regarding the use of BIM in design and its effectiveness.

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APPENDIX A

IRB Approval

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 7/24/2015

To: Dr. Douglas Gransberg
394 Town Engineering

CC: Emily Craigie
2711 South Loop Drive, Suite 4700

From: Office for Responsible Research

Title: NCHRP Project 15-51 Preconstruction Services Cost Estimating Guidebook

IRB ID: 15-366

Study Review Date: 7/24/2015

The project referenced above has been declared exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b) because it meets the following federal requirements for exemption:

- (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures with adults or observation of public behavior where
  - Information obtained is recorded in such a manner that human subjects cannot be identified directly or through identifiers linked to the subjects; or
  - Any disclosure of the human subjects' responses outside the research could not reasonably place the subject at risk of criminal or civil liability or be damaging to their financial standing, employability, or reputation.

The determination of exemption means that:

- **You do not need to submit an application for annual continuing review.**
- **You must carry out the research as described in the IRB application.** Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any modifications to the research procedures (e.g., method of data collection, nature or scope of information to be collected, changes in confidentiality measures, etc.), modifications that result in the inclusion of participants from vulnerable populations, and/or any change that may increase the risk or discomfort to participants. Changes to key personnel must also be approved. The purpose of review is to determine if the project still meets the federal criteria for exemption.

  Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

  Detailed information about requirements for submission of modifications can be found on the Exempt Study Modification Form. A Personnel Change Form may be submitted when the only modification involves changes in study staff. If it is determined that exemption is no longer warranted, then an Application for Approval of Research Involving Humans Form will need to be submitted and approved before proceeding with data collection.

Please note that you must submit all research involving human participants for review. **Only the IRB or designees may make the determination of exemption,** even if you conduct a study in the future that is exactly like this study.

Please be aware that **approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **An IRB determination of exemption in no way implies or guarantees that permission from these other entities will be granted.**

Please don't hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.

IRB ID: 15-3100

INSTITUTIONAL REVIEW BOARD (IRB)

Exempt Study Review Form

RECEIVED
JUN 04 2015
By IRB

Title of Project: NCHRP Project 15-51 Preconstruction Services Cost Estimating Guidebook		
Principal Investigator (PI): **Doug Gransberg**		Degrees: PhD
University ID: **917840924**	Phone: 515 294 2140	Email Address: dgran@iastate.edu
Correspondence Address: 2711 South Loop Drive, Suite 4700, Ames, IA 50010-8664		
Department: CCEE		College/Center/Institute: Institute for Transportation

PI Level: ☒ Tenured, Tenure-Eligible, & NTER Faculty ☐ Adjunct/Affiliate Faculty ☐ Collaborator Faculty ☐ Emeritus Faculty
☐ Visiting Faculty/Scientist ☐ Senior Lecturer/Clinician ☐ Lecturer/Clinician, w/Ph.D. or DVM ☐ P&S Employee, P37 & above
☐ Extension to Families/Youth Specialist ☐ Field Specialist III ☐ Postdoctoral Associate ☐ Graduate/Undergrad Student ☐ Other (specify:)

FOR STUDENT PROJECTS *(Required when the principal investigator is a student)*			
Name of Major Professor/Supervising Faculty:			
University ID:	Phone:	Email Address:	@iastate.edu
Campus Address:		Department:	
Type of Project: (check all that apply)	☐ Thesis/Dissertation	☐ Class Project	☐ Other (specify:)

Alternate Contact Person: Emily Craigie	Email Address: ecraigie@iastate.edu
Correspondence Address: 2711 South Loop Drive, Suite 4700, Ames, IA 50010-8664	Phone: 515 817 3844

ASSURANCE

- I certify that the information provided in this application is complete and accurate and consistent with any proposal(s) submitted to external funding agencies. Misrepresentation of the research described in this or any other IRB application may constitute non-compliance with federal regulations and/or academic misconduct.
- I agree to provide proper surveillance of this project to ensure that the rights and welfare of the human subjects are protected. I will report any problems to the IRB. See Reporting Adverse Events and Unanticipated Problems for details.
- I agree that modifications to the approved project will not take place without prior review and approval by the IRB.
- I agree that the research will not take place without the receipt of permission from any cooperating institutions, when applicable.
- I agree to obtain approval from other appropriate committees as needed for this project, such as the IACUC (if the research includes animals), the IBC (if the research involves biohazards), the Radiation Safety Committee (if the research involves x-rays or other radiation producing devices or procedures), etc.; and to obtain background checks for staff when necessary.
- I understand that IRB approval of this project does not grant access to any facilities, materials, or data on which this research may depend. Such access must be granted by the unit with the relevant custodial authority.
- I agree that all activities will be performed in accordance with all applicable federal, state, local, and Iowa State University policies.

[redacted] 5-26-15
Signature of Principal Investigator Date

Signature of Major Professor/Supervising Faculty Date
(Required when the principal investigator is a student)

- I have reviewed this application and determined that departmental requirements are met, the investigator(s) has/have adequate resources to conduct the research, and the research design is scientifically sound and has scientific merit.

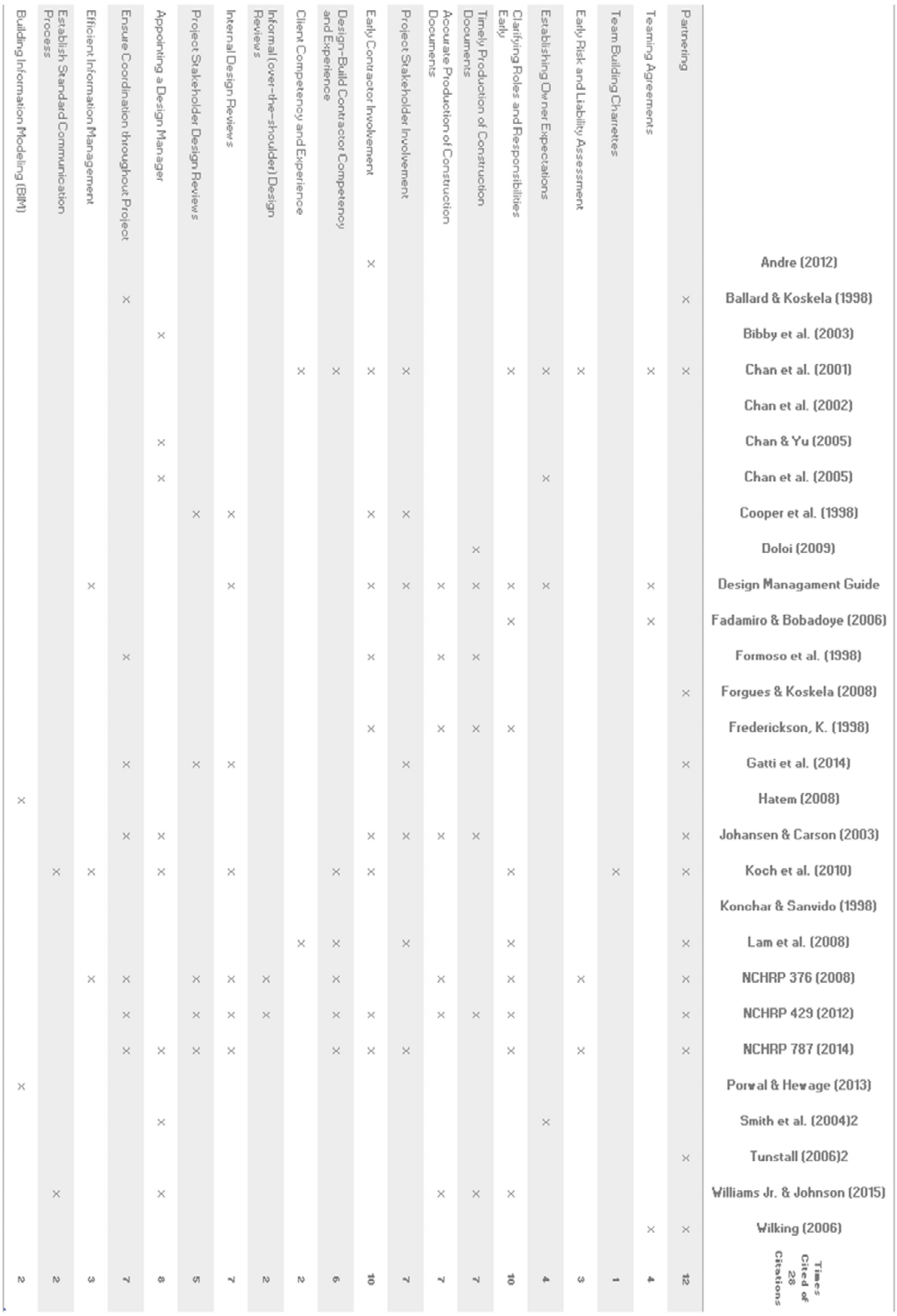
[redacted]
Printed Name of Department Chair/Head/Director

[redacted] 5/28/15
Signature of Department Chair/Head/Director Date

For IRB Use Only	☐ Not Research Per Federal Regulations	☐ No Human Participants	Review Date: 7/24/15
	☐ Minimal Risk	EXEMPT Per 45 CFR 46.101(b): 2	
IRB Reviewer's Signature	[redacted] 7/24/15		

APPENDIX B

CONTENT ANALYSIS



	Andre (2012)	Ballard & Koskela (1998)	Bibby et al. (2003)	Chan et al. (2001)	Chan et al. (2002)	Chan & Yu (2005)	Chan et al. (2005)	Cooper et al. (1998)	Doloi (2009)	Design Managament Guide	Fadamiro & Bobadoye (2006)	Formoso et al. (1998)	Forgues & Koskela (2008)	Frederickson, K. (1998)	Gatti et al. (2014)	Hatem (2008)	Johansen & Carson (2003)	Koch et al. (2010)	Konchar & Sanvido (1998)	Lam et al. (2008)	NCHRP 376 (2008)	NCHRP 429 (2012)	NCHRP 787 (2014)	Porwal & Hewage (2013)	Smith et al. (2004)2	Tunstall (2006)2	Williams Jr. & Johnson (2015)	Wilking (2006)	Times Cited of 28 Citations
Partnering		×		×									×		×		×			×	×	×	×			×		×	12
Teaming Agreements				×						×	×																	×	4
Team Building Charrettes																		×											1
Early Risk and Liability Assessment				×																	×		×						3
Establishing Owner Expectations				×			×			×															×				4
Clarifying Roles and Responsibilities Early				×						×	×			×						×	×	×	×				×		10
Timely Production of Construction Documents									×	×		×		×			×				×	×					×		7
Accurate Production of Construction Documents										×		×		×			×				×	×					×		7
Project Stakeholder Involvement				×				×		×					×		×			×			×						7
Early Contractor Involvement		×		×				×		×		×		×			×				×	×	×						10
Design-Build Contractor Competency and Experience				×													×	×		×	×	×	×						6
Client Competency and Experience				×																×									2
Informal (over-the-shoulder) Design Reviews																					×	×							2
Internal Design Reviews								×		×					×		×	×		×	×	×	×						7
Project Stakeholder Design Reviews								×							×						×	×	×						5
Appointing a Design Manager			×			×	×										×	×					×						8
Ensure Coordination throughout Project		×										×			×		×			×	×	×	×						7
Efficient Information Management										×							×	×			×								3
Establish Standard Communication Process																		×									×		2
Building Information Modeling (BIM)																×								×					2

APPENDIX C

SURVEY DATA

Survey Questionnaire

Introduction	
1. Location:	
2. My organization is:	
An owner	
A design professional	
A builder	
A design-builder	
A construction manager	
3. Organization Type:	
Public Agency	
Private Company	
4. What capabilities does your organization have? Please check all that apply.	
In-house design	
In-house construction	
In-house contract administration	
Design-Build Experience	
5. Which project delivery methods other than design-bid-build have you used before? Please check all that apply.	
Design-Build	
Construction Manager as Agent	
Construction Manager at Risk	
6. Do you have previous design-build experience?	
Yes	
No	
7. How many years and in how many projects have you used design-build?	
Design-Build Years	
Design-Build Projects	
8. In what sectors have you used the design-build delivery method?	
Public Only	
Private Only	

Both	
Not Applicable	
9. If you have used design-build for public projects, please specify which type. Please check all public project types that apply.	
Federal Projects	
State Projects	
Other Projects	
Not Applicable	
10. On what type of projects have you used design-build? Please check all that apply.	
Commercial	
Industrial	
Heavy-Highway	
Residential	
Other	
Not Applicable	
11. If you are an owner, which are the reasons why you have used design build? If you are not an owner, which of the following reasons do you believe owners cite	
Innovation	
Cost savings	
Early cost establishment	
Reduced schedule	
Qualifications- based selection of both the designer and the builder	
Single entity responsible for design and construction	
Builder involvement in the design process	
Enhance quality	
Best value selection	
12. Please rank the following reasons for selecting design-build in order of importance, 1 being the most important.	
Innovation	
Cost savings	
Early cost establishment	
Reduced schedule	
Qualification- based selection of both the designer and the builder	
Single entity responsible for design and construction	
Builder involvement in the design process	

Enhance quality	
Best value selection	
13. When a Request for Qualifications is published, which do you think are the key items to successfully make it to the short list? Please rank them in order of importance, 1 being the most important.	
Key personnel experience	
Management plan	
Relative experience	
Design/Technical approach	
Past performance on projects with similar scope	
Schedule	
Subcontracting plan	
14. Which do you think are the key items to successfully respond to an RFP and win the project? Please rank them in order of importance, 1 being the most important.	
Price	
Technical/ Design approach	
Qualifications	
Schedule	
Management plans	
15. How much weight is assigned to price in the design-build method?	
0%	
10%	
25%	
50%	
75%	

16. Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Managing Cost Growth					
Construction cost growth can be minimized by active collaboration between the designer and the contractor's preconstruction staff during the preparation of the design documents.					
Construction cost growth can be minimized by timely review and approval by the owner of design documents.					
Construction cost growth can be minimized by the early contractor budget input to the designer regarding contract proposal price constraints.					

Construction cost growth decreases as the number of contractor design reviews increase.					
Construction cost growth decreases as the number of owner design reviews increase.					
Construction cost growth decreases as the amount of time to complete the design increases.					
17. Please describe any other factors that may affect cost growth in design build projects.					
Managing Schedule Growth					
18. Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Construction time growth can be minimized by active collaboration between the designer and the contractor's preconstruction staff during the preparation of the design documents.					
Construction time growth can be minimized by timely review and approval by the owner of design documents.					
Construction time growth can be minimized by the early contractor budget input to the designer regarding contract proposal price constraints.					
Construction time growth decreases as the number of contractor design reviews increase.					
Construction time growth decreases as the number of owner design reviews increase.					
Construction time growth decreases as the amount of time to complete the design increases.					
19. Please describe any other factors that may affect time growth in design build projects.					
Managing Scope Creep Risk					
20. Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Scope creep risk increases as the level of specific design information in the RFP decreases.					
Scope creep risk increases as the timeliness of contractor constructability reviews decreases.					
Scope creep risk increases as contractor budget input to the designer regarding contract proposal price constraints decreases.					
Scope creep risk increases as the number of contractor design reviews decreases.					

Scope creep risk increases as the number of owner design reviews increase.					
Scope creep risk increases as the amount of time to complete the design increases.					
21. Please describe any other factors that may affect scope creep in design build projects.					
Stakeholder Design Input					
22. Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Early contractor participation is important in design administration for design-build projects.					
Periodic informal (over-the-shoulder) design reviews are important for design administration for design-build projects.					
Appointing a single individual on the design-builder's preconstruction staff as the design manager improves the quality of the final design documents.					
Appointing a single individual on the design-builder's preconstruction staff as the design manager reduces construction cost growth.					
Appointing a single individual on the design-builder's preconstruction staff as the design manager reduces project time growth.					
Appointing a single individual on the design-builder's preconstruction staff as the design manager reduces scope creep risk.					
Building information modeling (BIM) improves the quality of the final design documents.					
BIM reduces construction cost growth.					
BIM reduces project time growth					
BIM reduces scope creep risk.					
Expectations and Relationships					
23. Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Early establishment of owner project expectations is important in design administration for design-build projects.					
Early establishment of the design-build team's project expectations is important in design administration for design-build projects.					
A post-award design charrette adds value to the design					

administration process.					
Establishing a standardized method for technical communication and documentation is important in design administration for design-build projects.					
Setting up digital communications tools such as FTP sites, drop boxes, etc. adds value to the design administration process.					
A cohesive team is important in design administration for design-build projects.					
A formal partnering workshop adds value to the relationships between members of the design-build team and the owner's team.					
Developing dispute/disagreement escalation ladder between the owner's design review team and the design-build team adds value to the design administration process.					
Developing an internal DB team dispute/ disagreement escalation ladder adds value to the design administration process.					
24. Please list any other factors that are important in design administration for design build projects.					
Design Reviews					
25. Indicate the your opinion of the frequency at which the following events should occur during design administration to ensure a final design that meets DB contract scope, cost, and schedule requirements.	Never	Weekly	Bi-weekly	Monthly	At the end of each design phase
Owner criteria compliance checks					
Building code analysis and reviews					
Constructability reviews					
Design peer reviews					
Design standard checks					
Informal/over-the-shoulder reviews of design in progress with the owner					
Informal/over-the-shoulder reviews of design in progress with the contractor					
Trade subconsultant involvement in the design review process					
Material/equipment supplier involvement in the design review process					

Survey Response Matrix

	1= Yes 2= No													
	RespondentID	4569907095	4566840491	4565633619	4562581418	4560707997	4557526846	4555087458	4554276682	4554272893	4554011515	4552074601	4550806394	4550063914	4549749542
	StartDate	9-Mar-16	8-Mar-16	8-Mar-16	7-Mar-16	6-Mar-16	4-Mar-16	3-Mar-16	3-Mar-16	3-Mar-16	3-Mar-16	2-Mar-16	2-Mar-16	2-Mar-16	2-Mar-16
1	What is your location?	DAL	FTW	DAL	DAL	DAL	DAL	DAL	DAL	DFW	DAL	DAL	DFW	DAL	DAL
2	My organization is:	DBr	Dsgn	Bldr	DBr	DBr	Bldr	DBr	DBr	Bldr	Owner	Dsgn	Bldr	Dsgn	Bldr
3	My organization type is a:														
	Public Agency														1
	Private Company	1	1	1	1	1	1	1	1	1	1	1	1	1	
4	What capabilities does your organization have? Please check all that apply														
	In-house design	1	1		1	1		1	1	1		1		1	
	In-house construction	1	1	1	1	1	1	1	1	1			1		1
	In-house contract administration	1	1	1	1	1		1	1	1	1			1	1
5	Which project delivery methods other than design-bid-build have you used before? Please check all that apply.														
	Design-Build	1	1	1	1	1		1	1	1		1		1	1
	CMA				1	1		1			1	1			1
	Construction Manager at Risk			1	1	1		1	1		1	1		1	1
6	Do you have previous design-build experience?	1	1	1	1	1		1	1	1	2	1		1	1
7	How many years and in how many projects have you used the design-build method?														
	Number of design-build years	22	12	8	1	15		16	18	20	0			2	15
	Number of design-build projects	50	5	6	1	5		100	80	100	0	3		2	15
8	In what sectors have you the design-build?														
	Public Only														
	Private Only	1		1	1							1		1	
	Both		1			1		1	1	1					1
	Not Applicable										1				
9	If you have used design-build for public projects, please specify which type. Please check all public project types that apply.														
	Federal Projects					1		1	1	1					1
	State Projects							1	1	1					1
	NA			1	1						1	1		1	
	Other (please specify)		1												
10	On what type of projects have you used design-build? Please check all that apply.														
	Commercial	1	1	1		1		1	1	1		1		1	1
	Industrial	1													
	Heavy-Highway														
	Residential														
	Not Applicable										1				
	Other (please specify)				1			1	1						

11	If you are an owner, which are the reasons why you have used design build? If you are not an owner, which of the following reasons do you believe owners cite when choosing to use design-build?													
	Innovation	1		1										
	Cost savings	1	1	1					1				1	1
	Early cost establishment					1		1	1	1				1
	Reduced schedule	1	1	1		1			1			1	1	1
	Qualification-based selection of both the designer and the builder	1							1					1
	Single entity responsible for design and construction					1		1	1					1
	Builder involvement in the design process	1				1		1	1	1				1
	Enhance quality	1				1								1
	Best value selection			1						1				1
12	Please rank the following reasons for selecting design-build in order of importance, 1 being the most important.													
	Innovation	3	9		9	7		8	9	1			8	9
	Cost savings	2	2		8	8		9	1	7			2	6
	Early cost establishment		3		7	5		2	3	2		2	1	1
	Reduced schedule	1	1		6	6		6	2	9		1	3	2
	Qualification-based selection of both the designer and the builder	4	4	3	1	1		7	6	6		3	9	7
	Single entity responsible for design and construction		5	7	5	9		1	4	8			7	3
	Builder involvement in the design process	6	7		2	2		3	5	3		4	6	5
	Enhance quality	5	8	2	4	3		4	7	4			4	8
	Best value selection		6	1	3	4		5	8	5			5	4
13	When a Request for Qualifications is published, which do you think are the key items to successfully make it to the short list? Please rank them in order of importance, 1 being the most important.													
	Key personnel experience	1	4	2	2	2		2	1	4	4	2	2	1
	Management plan	7	6	7	5	4		6	6	5	5	5	5	3
	Relative experience	3	2	3	1	3		3	3	3	3	1	1	2
	Design/Technical approach	4	1	6	4	7		4	5	1	6	4	6	5
	Past performance on projects with similar s	2	3	4	3	1		1	2	2	2	3	3	4
	Schedule	5	5	1	6	5		5	4	6	1	6	4	6
	Subcontracting plan	6	7	5	7	6		7	7	7	7	7	7	7
14	Which do you think are the key items to successfully respond to an RFP and win the project? Please rank them in order of importance, 1 being the most important.													
	Price	3	1	3	2	3		1	1	3	2	3	5	1
	Technical / Design approach	4	2	4	1	5		4	4	2	5	2	2	4
	Qualifications	1	3	2	3	1		2	3	1	1	1	1	3
	Schedule	2	4	1	4	4		3	2	5	3	4	4	2
	Management plans	5	5	5	5	2		5	5	4	4	5	3	5
15	How much weight is assigned to price in the design-build method?													
	0%										1			
	10%	1												
	25%				1							1	1	
	50%		1	1		1		1	1	1				
	75%													1

	1= Strongly Disagree 2= Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree														
16	Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.														
	Construction cost growth can be minimized by active collaboration between the designer and the contractor's preconstruction staff during the preparation of the design documents.	5	4	5	5	5		5	5	5	5	5		3	5
	Construction cost growth can be minimized by timely review and approval by the owner of design documents.	5	4	4	4	4		5	3	3	4	4		2	5
	Construction cost growth can be minimized by the early contractor budget input to the designer regarding contract proposal price constraints.	5	3	4	5	5		5	5	4	5	5		4	5
	Construction cost growth decreases as the number of contractor design reviews increase.	4	2	2	4	4		2	4	4	4	3		4	5
	Construction cost growth decreases as the number of owner design reviews	4	2	2	4	4		2	2	3	4	3		2	5
	Construction cost growth goes down as the amount of time to complete the	4	3	2	4	4		2	3	4	2	2		2	5
17	Please describe any other factors that may affect cost growth in design build projects.	REF				REF		REF			REF			REF	
18	Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.														
	Construction time growth can be minimized by active collaboration between the designer and the contractor's preconstruction staff during the preparation of the design documents.	5	4	4	4	5		4	4	4	4	4		4	5
	Construction time growth can be minimized by timely review and approval by the owner of design documents.	5	4	2	5	5		4	5	4	5	4		2	5
	Construction time growth can be minimized by the early contractor budget input to the designer regarding contract proposal price constraints.	5	3	4	4	5		2	4	5	4	3		4	5
	Construction time growth decreases as the number of contractor design reviews increase.	4	3	4	4	4		3	4	3	3	3		3	5
	Construction time growth decreases as the number of owner design reviews increase.	4	3	2	4	4		3	4	3	3	3		2	5
	Construction time growth decreases as the amount of time to complete the design increases.	4	3	2	4	4		2	2	2	3	4		3	5
19	Please describe any other factors that may affect time growth in design build projects.					REF		REF			REF				

20	Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.														
	Scope creep risk increases as the level of specific design information in the RFP decreases.	1	4	5	4	5		4	5	4	4	2		2	5
	Scope creep risk increases as the timeliness of contractor constructability reviews decreases.	1	2	3	4	5		4	4	3	4	3		2	5
	Scope creep risk increases as contractor budget input to the designer regarding contract proposal price constraints decreases.	1	2	4	5	5		4	5	4	5			4	5
	Scope creep risk increases as the number of contractor design reviews decreases.	4	2	4	4	4		5	5	2	4	4		4	5
	Scope creep risk increases as the number of owner design reviews increase.	2	4	2	3	4		5	1	4	3	2		3	5
	Scope creep risk increases as the amount of time to complete the design increases.	2	4	2	3	4		5	2	3	4	2		2	5
21	Please describe any other factors that may affect scope creep in design build projects.										REF				
22	Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.														
	Early contractor participation is important in design administration for design-build projects.	5	4	4	4	5		5	5	4				4	5
	Periodic informal (over-the-shoulder) design reviews are important for design administration for design-build projects.	4	3	4	5	5		5	5	4				3	5
	Appointing a single individual on the design-builder's preconstruction staff as the design manager improves the quality of the final design documents.	5	4	4	4	5		1	4	3				3	5
	Appointing a single individual on the design-builder's preconstruction staff as the design manager reduces construction cost growth.	5	4	4	4	5		4	5	3				3	5
	Appointing a single individual on the design-builder's preconstruction staff as the design manager reduces project time growth.	5	3	3	3	4		3	4	3				2	5
	Appointing a single individual on the design-builder's preconstruction staff as the design manager reduces scope creep risk.	5	3	4	4	4		4	5	3				4	5
	Building information modeling (BIM) improves the quality of the final design documents.	4	3	3	3	5		5	5	2	3			4	5
	BIM reduces construction cost growth.	4	3	2	3	5		5	3	2	3			4	3
	BIM reduces project time growth.	4	3	4	3	5		3	3	2	3			4	3
	BIM reduces scope creep risk.	4	3	2	3	5		5	4	2	4			4	3

23	Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.														
	Early establishment of owner project expectations is important in design administration for design-build projects.	5	4	4	5	5		5	5	4	5			4	5
	Early establishment of the design-build team's project expectations is important in design administration for design-build projects	5	4	4	5	5		5	5	4	4			4	5
	A post-award design charrette adds value to the design administration process.	5	4	4	4	5		5	5	4	5			4	5
	Establishing a standardized method for technical communication and documentation is important in design administration for design-build projects.	5	4	4	5	5		4	5	5	5			4	5
	Setting up digital communications tools such as FTP sites, drop bo1es, etc. adds value to the design administration for design-build projects.	5	4	4	4	4		3	5	5	4			4	5
	A cohesive team is important in design administration for design-build projects.	5	4	4	5	5		5	5	5	5			5	5
	A formal partnering workshop adds value to the relationships between members of the design-build team and the owner's team.	4	4	4	5	5		5	5	4	4			4	5
	Developing disputement escalation ladder between the owner's design review team and the design-build team adds value to the design administration	4	3	4	5	5		5	4	3	4			3	5
	Developing an internal design-build team dispute/ disagreement escalation ladder adds value to the design administration process.	4	3	4	5	5		5	4	3	3			3	5
24	Please list any other factors that are important in design administration for design build projects.										REF				
	1= Never 2= Weekly 3 = Bi-Weekly 4 = 4nthly 5 =At the 5 of each design phase														
25	Indicate the your opinion of the frequency at which the following events should occur during design administration to ensure a final design that meets DB contract scope, cost, and schedule requirements.														
	Owner criteria compliance checks	2	4	4	4	4		5	2	5				3	5
	Building code analysis and reviews	3	5	3	4	4		5	5	5				5	5
	Constructability reviews	2	4	3	3	4		5	4	4				3	5
	Design peer reviews	4	4	5	4	5		5	5	5				5	5
	Design standard checks	4	5	5	3	4		3	5	5				3	5
	Informal/over-the-shoulder reviews of design in progress with the owner	2	3	3	3	4		3	3	3				3	4
	Informal/over-the-shoulder reviews of design in progress with the contractor	2	3	2	3	4		3	2	3				3	4
	Trade subconsultant involvement in the design review process	2	3	3	2	4		3	5	4				4	5
	Material/equipment supplier involvement in the design review process	2	3	3	2	4		5	5	4				4	5

	1= Yes 2= No													
	RespondentID	4549395142	4549277533	4549215910	4549148753	4547973223	4547834412	4547764781	4547750502	4547744463	4547740698	4547618292	4544906457	4544875422	4538702297
	StartDate	1-Mar-16	1-Mar-16	1-Mar-16	1-Mar-16	1-Mar-16	1-Mar-16	1-Mar-16	1-Mar-16	1-Mar-16	1-Mar-16	1-Mar-16	29-Feb-16	29-Feb-16	25-Feb-16
1	What is your location?	DFW	DAL	DAL	HOU	DAL	ATL	FTW	DAL	HOU	DAL	FTW	FTW	DAL	DAL
2	My organization is:	Owner	DBr	DBr	DBr	DBr	DBr	Dsgn	Bldr	DBr	Bldr	Bldr	DBr	DBr	DBr
3	My organization type is a:														
	Public Agency						1								
	Private Company	1	1	1	1	1		1	1	1	1	1	1	1	1
4	What capabilities does your organization have? Please check all that apply														
	In-house design	1	1		1	1	1	1		1	1		1	1	1
	In-house construction	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	In-house contract administration	1	1		1	1	1	1		1			1	1	1
5	Which project delivery methods other than design-bid-build have you used before? Please check all that apply.														
	Design-Build		1	1	1			1	1	1	1		1		1
	CMA		1								1		1		1
	Construction Manager at Risk	1	1	1			1				1		1		1
6	Do you have previous design-build experience?	1	1	1	1		1	1	1	1	1		1		1
7	How many years and in how many projects have you used the design-build method?														
	Number of design-build years		70	3	15		15	15	10	5	15		15		25
	Number of design-build projects		1000	3	35		40	145	4	3	20		20		500
8	In what sectors have you the design-build?														
	Public Only										1				
	Private Only	1	1	1	1				1				1		
	Both						1	1		1					1
	Not Applicable														
9	If you have used design-build for public projects, please specify which type. Please check all public project types that apply.														
	Federal Projects							1		1					1
	State Projects						1	1							
	NA		1	1	1				1		1		1		
	Other (please specify)														
10	On what type of projects have you used design-build? Please check all that apply.														
	Commercial	1	1	1	1		1	1	1	1	1		1		1
	Industrial		1					1			1				
	Heavy-Highway														
	Residential										1				1
	Not Applicable														
	Other (please specify)						1								

11	If you are an owner, which are the reasons why you have used design build? If you are not an owner, which of the following reasons do you believe owners cite when choosing to use design-build?													
	Innovation				1				1	1	1			
	Cost savings				1		1	1	1	1	1		1	
	Early cost establishment		1	1	1		1	1	1	1			1	
	Reduced schedule		1	1	1		1		1	1			1	
	Qualification-based selection of both the designer and the builder		1		1		1	1	1	1	1			
	Single entity responsible for design and construction	1	1	1	1				1	1			1	
	Builder involvement in the design process	1	1		1				1	1	1		1	
	Enhance quality	1	1		1		1		1	1			1	
	Best value selection	1			1		1		1	1	1			
12	Please rank the following reasons for selecting design-build in order of importance, 1 being the most important.													
	Innovation	8	5	8	5		5		6	3	6		8	8
	Cost savings	5	6	5	3		1	1	1	1	1		1	6
	Early cost establishment	6	1	2	2		2	3	2	2	8		6	3
	Reduced schedule	9	2	3	6		3		3	4	7		2	4
	Qualification-based selection of both the designer and the builder	7	4	4	7		4	2	9	8	5		9	9
	Single entity responsible for design and construction	3	3	1	4		6		8	5	9		3	2
	Builder involvement in the design process	2	7	9	1		7		7	9	2		4	5
	Enhance quality	4	8	7	8		8		5	7	3		5	7
	Best value selection	1	9	6	9		9		4	6	4		7	1
13	When a Request for Qualifications is published, which do you think are the key items to successfully make it to the short list? Please rank them in order of importance, 1 being the most important.													
	Key personnel experience	1	2	1	4		3	2	3	4	1		5	1
	Management plan	7	4	4	5		7	4	5	5	6		6	5
	Relative experience	2	3	3	2		2	3	2	7	2		2	3
	Design/Technical approach	4	5	2	3		6	5	4	1	5		3	4
	Past performance on projects with similar s	3	1	6	1		1	6	1	3	3		1	2
	Schedule	6	6	5	6		5	1	6	2	4		4	6
	Subcontracting plan	5	7	7	7		4	7	7	6	7		7	7
14	Which do you think are the key items to successfully respond to an RFP and win the project? Please rank them in order of importance, 1 being the most important.													
	Price	3	2	2	1		2	1	1	3	1		1	3
	Technical / Design approach	2	4	3	3		3	4	3	1	4		4	2
	Qualifications	1	1	1	2		1	3	2	2	3		3	1
	Schedule	4	5	4	5		4	2	4	4	2		2	4
	Management plans	5	3	5	4		5	5	5	5	5		5	5
15	How much weight is assigned to price in the design-build method?													
	0%													
	10%													
	25%	1		1										1
	50%		1				1	1		1				
	75%				1				1		1		1	

	1= Strongly Disagree 2= Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree													
16	Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.													
	Construction cost growth can be minimized by active collaboration between the designer and the contractor's preconstruction staff during the preparation of the design documents.	5	5	5	4		5	5	5	5	4		5		5
	Construction cost growth can be minimized by timely review and approval by the owner of design documents.	5	3	5	5		5	5	4	5	5		5		5
	Construction cost growth can be minimized by the early contractor budget input to the designer regarding contract proposal price constraints.	5	4	5	5		5	5	4	5	5		4		5
	Construction cost growth decreases as the number of contractor design reviews increase.	2	4	3	5		4	5	3	5	3		4		4
	Construction cost growth decreases as the number of owner design reviews	2	3	3	3		4	5	3	5	3		3		4
	Construction cost growth goes down as the amount of time to complete the	2	1	2	1		4	5	4	5	3		2		3
17	Please describe any other factors that may affect cost growth in design build projects.		REF		REF				REF				REF		
18	Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.													
	Construction time growth can be minimized by active collaboration between the designer and the contractor's preconstruction staff during the preparation of the design documents.	5	5	4	5		5	5	4	5	4		4		5
	Construction time growth can be minimized by timely review and approval by the owner of design documents.	5	4	5	5		5	5	4	5	4		5		5
	Construction time growth can be minimized by the early contractor budget input to the designer regarding contract proposal price constraints.	5	4	5	5		5	5	4	5	4		4		4
	Construction time growth decreases as the number of contractor design reviews increase.	3	4	2	5		4	5	4	5	3		4		4
	Construction time growth decreases as the number of owner design reviews increase.	3	3	2	3		4	5	4	5	3		2		4
	Construction time growth decreases as the amount of time to complete the design increases.	1	3	3	2		4	5	4	5	3		1		4
19	Please describe any other factors that may affect time growth in design build projects.								REF				REF		

20	Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.													
	Scope creep risk increases as the level of specific design information in the RFP decreases.	4	4	4	5		2	4	4	5	4		5		
	Scope creep risk increases as the timeliness of contractor constructability reviews decreases.		4	5	5		4	3	4	5	5		4		
	Scope creep risk increases as contractor budget input to the designer regarding contract proposal price constraints decreases.	3	4	5	5		4	4	4	5	5		5		
	Scope creep risk increases as the number of contractor design reviews decreases.	5	4	4	5		4	5	4	5	5		5		
	Scope creep risk increases as the number of owner design reviews increase.	3	3	4	4		2	5	2	2	3		4		
	Scope creep risk increases as the amount of time to complete the design increases.	3	4	5	4		3	5	2	2	3		3		
21	Please describe any other factors that may affect scope creep in design build projects.												REF		
22	Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.													
	Early contractor participation is important in design administration for design-build projects.	5	5	5	5		5	5	4	5	5		5		
	Periodic informal (over-the-shoulder) design reviews are important for design administration for design-build projects.	5	5	5	5		4	4	4	5	5		5		
	Appointing a single individual on the design-builder's preconstruction staff as the design manager improves the quality of the final design documents.	5	5	5	5		4	4	3	5	1		4		
	Appointing a single individual on the design-builder's preconstruction staff as the design manager reduces construction cost growth.	5	5	5	4		4	4	3	5	2		5		
	Appointing a single individual on the design-builder's preconstruction staff as the design manager reduces project time growth.	5	5	4	4		4	4	3	5	2		3		
	Appointing a single individual on the design-builder's preconstruction staff as the design manager reduces scope creep risk.	5	5	4	4		4	5	3	5	2		5		
	Building information modeling (BIM) improves the quality of the final design documents.	5	5	5	3		4	4	4	3	4		5		
	BIM reduces construction cost growth.	5	5	3	3		4	3	4	3	3		5		
	BIM reduces project time growth.	5	5	3	3		4	3	3	3	3		5		
	BIM reduces scope creep risk.	3	5	3	3		4	3	3	3	3		5		

23	Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.														
	Early establishment of owner project expectations is important in design administration for design-build projects.	5	5	5	5		5	4	4	5	5		5		
	Early establishment of the design-build team's project expectations is important in design administration for design-build projects	5	4	5	5		4	4	4	5	5		5		
	A post-award design charrette adds value to the design administration process.	5	4	5	5		4	5	3	5	4		5		
	Establishing a standardized method for technical communication and documentation is important in design administration for design-build projects.	3	4	5	5		4	4	4	5	5		5		
	Setting up digital communications tools such as FTP sites, drop bo1es, etc. adds value to the design administration for design-build projects.	3	4	5	5		5	3	4	5	5		5		
	A cohesive team is important in design administration for design-build projects.		4	5	5		5	5	4	5	5		5		
	A formal partnering workshop adds value to the relationships between members of the design-build team and the owner's team.	5	4	5	5		5	4	4	5	4		5		
	Developing disputement escalation ladder between the owner's design review team and the design-build team adds value to the design administration	5	4	3	5		4	3	4	5	4		4		
	Developing an internal design-build team dispute/ disagreement escalation ladder adds value to the design administration process.	5	4	3	5		4	3	4	5	4		5		
24	Please list any other factors that are important in design administration for design build projects.												REF		
	1= Never 2= Weekly 3 = Bi-Weekly 4 = 4nthly 5 =At the 5 of each design phase														
25	Indicate the your opinion of the frequency at which the following events should occur during design administration to ensure a final design that meets DB contract scope, cost, and schedule requirements.														
	Owner criteria compliance checks	5	2	3	3		2	4	4	2	5		4		
	Building code analysis and reviews	5	4	3	3		4	5	4	5	4		4		
	Constructability reviews	5	3	2	3		3	5	4	3	4		3		
	Design peer reviews	3	4	4	3		3	5	4	3	3		3		
	Design standard checks	3	3	4	3		3	4	4	3	3		2		
	Informal/over-the-shoulder reviews of design in progress with the owner	2	2	3	2		3	4	4	2	3		3		
	Informal/over-the-shoulder reviews of design in progress with the contractor	2	2	2	2		3	5	4	3	3		2		
	Trade subconsultant involvement in the design review process	4	4	3	2		2	4	5	3	4		2		
	Material/equipment supplier involvement in the design review process	4	3	3	4		4	4	5	3	4		4		

	1= Yes 2= No													
	RespondentID	4538421975	4538174725	4538004253	4537860208	4537789114	4537366387	4537151395	4537128123	4537121686	4537117295	4537078601	4537048641	4536959613	4474671180
	StartDate	25-Feb-16	25-Feb-16	25-Feb-16	25-Feb-16	25-Feb-16	25-Feb-16	25-Feb-16	25-Feb-16	25-Feb-16	25-Feb-16	25-Feb-16	25-Feb-16	25-Feb-16	28-Jan-16
1	What is your location?	DAL	DAL	DAL	DAL	DAL	DAL	DAL	DFW	DEN	DAL	DAL	DAL	DAL	DF
2	My organization is:	DBr	CM	Bldr	DBr	CM	DBr	DBr	DBr	DBr	Dsgn	DBr	Bldr	DBr	Bldr
3	My organization type is a:														
	Public Agency														
	Private Company	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	What capabilities does your organization have? Please check all that apply														
	In-house design	1		1	1	1	1	1	1	1	1	1	1	1	1
	In-house construction	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	In-house contract administration			1		1	1	1	1	1	1	1	1		1
5	Which project delivery methods other than design-bid-build have you used before? Please check all that apply.														
	Design-Build		1	1	1	1		1	1	1		1	1	1	1
	CMA		1			1						1			
	Construction Manager at Risk		1	1	1	1		1	1	1		1	1	1	1
6	Do you have previous design-build experience?	1	1	1	1	1		1	2	1		1	2	1	1
7	How many years and in how many projects have you used the design-build method?														
	Number of design-build years	2	2	10	16	1		5	7	2		2	0	2	40
	Number of design-build projects	1	1	12	7	3		4	1	1		1	0	1	25
8	In what sectors have you the design-build?														
	Public Only														
	Private Only	1	1	1	1	1		1		1		1	1	1	
	Both								1						1
	Not Applicable														
9	If you have used design-build for public projects, please specify which type. Please check all public project types that apply.														
	Federal Projects														1
	State Projects														
	NA	1	1	1	1			1		1		1	1	1	
	Other (please specify)								1						
10	On what type of projects have you used design-build? Please check all that apply.														
	Commercial	1	1	1	1	1		1		1		1	1	1	1
	Industrial					1									1
	Heavy-Highway														
	Residential														
	Not Applicable														
	Other (please specify)								1						

11	If you are an owner, which are the reasons why you have used design build? If you are not an owner, which of the following reasons do you believe owners cite when choosing to use design-build?													
	Innovation								1	1				
	Cost savings								1	1		1		1
	Early cost establishment				1			1	1	1		1	1	1
	Reduced schedule					1		1	1	1				1
	Qualification-based selection of both the designer and the builder								1				1	
	Single entity responsible for design and construction							1	1	1		1		1
	Builder involvement in the design process		1		1			1	1			1		1
	Enhance quality							1	1			1		
	Best value selection				1				1	1				1
12	Please rank the following reasons for selecting design-build in order of importance, 1 being the most important.													
	Innovation		6	6		3		7	2	9		7	8	9
	Cost savings		5	2		4		5	8	3		5	9	1
	Early cost establishment		2	3	2	5		4	3	5		2	2	5
	Reduced schedule		7	1		1		6	9	1		8	3	2
	Qualification-based selection of both the designer and the builder		3	5		6		8	7	6		9	4	7
	Single entity responsible for design and construction		4	9		9		3	6	4		4	5	3
	Builder involvement in the design process		1	4	1	2		2	1	8		6	6	4
	Enhance quality		8	7		8		1	4	7		3	7	8
	Best value selection		9	8	3	7		9	5	2		1	1	6
13	When a Request for Qualifications is published, which do you think are the key items to successfully make it to the short list? Please rank them in order of importance, 1 being the most important.													
	Key personnel experience		3	1	1	5		3	2	5		4	2	2
	Management plan		5	2	5	4		5	3	6		3	5	5
	Relative experience		2	3	2	3		1	4	1		5	4	4
	Design/Technical approach		7	4	6	6		4	5	2		2	3	3
	Past performance on projects with similar scope		1	5	3	2		2	1	3		1	1	1
	Schedule		4	6	4	1		6	6	4		6	6	
	Subcontracting plan		6	7	7	7		7	7	7		7	7	7
14	Which do you think are the key items to successfully respond to an RFP and win the project? Please rank them in order of importance, 1 being the most important.													
	Price	2	2	3	1	1		2	1	2		1	1	3
	Technical / Design approach	5	5	5	4	4		3	2	4		3	3	2
	Qualifications	1	1	1	2	2		1	4	1		4	2	1
	Schedule	4	3	4	3	3		4	3	3		2	4	4
	Management plans	3	4	2	5	5		5	5	5		5	5	5
15	How much weight is assigned to price in the design-build method?													
	0%													
	10%							1						
	25%					1								1
	50%	1			1				1	1		1		
	75%		1	1									1	

	1= Strongly Disagree 2= Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree														
16	Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.														
	Construction cost growth can be minimized by active collaboration between the designer and the contractor's preconstruction staff during the preparation of the design documents.	5	4	5	5	5		4	4	5		5	5	4	5
	Construction cost growth can be minimized by timely review and approval by the owner of design documents.	4	4	5	3	4		3	5	4		5	5	4	4
	Construction cost growth can be minimized by the early contractor budget input to the designer regarding contract proposal price constraints.	4	5	3	4	5		3	5	5		5	5	5	4
	Construction cost growth decreases as the number of contractor design reviews increase.	4	4	4	4	3		2	4	5		5	4	4	
	Construction cost growth decreases as the number of owner design reviews	4	3	4	3	3		2	5	4		5	2	4	3
	Construction cost growth goes down as the amount of time to complete the	4	5	3	3	4		2	5	4		3	4	3	3
17	Please describe any other factors that may affect cost growth in design build projects.							REF						REF	
18	Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.														
	Construction time growth can be minimized by active collaboration between the designer and the contractor's preconstruction staff during the preparation of the design documents.	3	4	5	4	4		4	5	5		5	5	4	5
	Construction time growth can be minimized by timely review and approval by the owner of design documents.	5	5	5	3	5		4	5	4		5	5	5	5
	Construction time growth can be minimized by the early contractor budget input to the designer regarding contract proposal price constraints.	3	5	4	4	4		4	5	5		5	5	3	5
	Construction time growth decreases as the number of contractor design reviews increase.	3	4	4	4	2		3	4	5		3	4	3	3
	Construction time growth decreases as the number of owner design reviews increase.	3	4	4	3	2		2	5	4		4	3	3	3
	Construction time growth decreases as the amount of time to complete the design increases.	2	4	3	4	3		5	4	5		4	5	4	3
19	Please describe any other factors that may affect time growth in design build projects.														

20	Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.														
	Scope creep risk increases as the level of specific design information in the RFP decreases.	3	4	5	5	4		3	4	5		4	5	4	1
	Scope creep risk increases as the timeliness of contractor constructability reviews decreases.	3	4	4	4	1		3	4	5		5	5	4	1
	Scope creep risk increases as contractor budget input to the designer regarding contract proposal price constraints decreases.	3	3	4	5	2		3	4	4		5	4	3	1
	Scope creep risk increases as the number of contractor design reviews decreases.	3	4	4	4	2		3	4	5		5	4	3	1
	Scope creep risk increases as the number of owner design reviews increase.	4	4	4	4	1		3	4	4		3	3	3	1
	Scope creep risk increases as the amount of time to complete the design increases.	4	4	4	4	2		3	4	5		4	4	2	1
21	Please describe any other factors that may affect scope creep in design build projects.														
22	Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.														
	Early contractor participation is important in design administration for design-build projects.	3	5	5	5	5			4	5		5	5	4	1
	Periodic informal (over-the-shoulder) design reviews are important for design administration for design-build projects.	3	4	5	4	5			5	5		4	5	4	1
	Appointing a single individual on the design-builder's preconstruction staff as the design manager improves the quality of the final design documents.	3	5	5	2	4			5	5		5	5	5	1
	Appointing a single individual on the design-builder's preconstruction staff as the design manager reduces construction cost growth.	3	4	4	5	3			5	5		5	5	5	1
	Appointing a single individual on the design-builder's preconstruction staff as the design manager reduces project time growth.	3	5	4	2	3			5	5		5	5	2	1
	Appointing a single individual on the design-builder's preconstruction staff as the design manager reduces scope creep risk.	3	5	4	5	3			5	5		5	5	5	1
	Building information modeling (BIM) improves the quality of the final design documents.	4	4	3	4	5			5	5		5	5	5	1
	BIM reduces construction cost growth.	3	3	3	3	5			5	5		5	5	3	1
	BIM reduces project time growth.	3	3	3	3	5			5	5		5	5	4	1
	BIM reduces scope creep risk.	3	3	3	3	3			5	5		5	5	2	1

23	Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.														
	Early establishment of owner project expectations is important in design administration for design-build projects.	4	5		5	5			5	5		5	5	4	
	Early establishment of the design-build team's project expectations is important in design administration for design-build projects	4	5		4	4			5	5		5	5	5	
	A post-award design charrette adds value to the design administration process.	4	3		4	4			5	5		4	4	3	
	Establishing a standardized method for technical communication and documentation is important in design administration for design-build projects.	4	4		5	4			5	5		5	4	4	
	Setting up digital communications tools such as FTP sites, drop bo1es, etc. adds value to the design administration for design-build projects.	3	5		5	4			5	4		5	4	3	
	A cohesive team is important in design administration for design-build projects.	3	5		5	4			5	5		5	5	5	
	A formal partnering workshop adds value to the relationships between members of the design-build team and the owner's team.	4	3		5	4			5	5		4	4	3	
	Developing disputement escalation ladder between the owner's design review team and the design-build team adds value to the design administration	4	3		3	4			5	5		5	4	4	
	Developing an internal design-build team dispute/ disagreement escalation ladder adds value to the design administration process.	5	3		3	3			5	5		5	4	4	
24	Please list any other factors that are important in design administration for design build projects.														
	1= Never 2= Weekly 3 = Bi-Weekly 4 = 4nthly 5 =At the 5 of each design phase														
25	Indicate the your opinion of the frequency at which the following events should occur during design administration to ensure a final design that meets DB contract scope, cost, and schedule requirements.														
	Owner criteria compliance checks	3	3		4	5			3	5		5	2	2	
	Building code analysis and reviews	3	4		5	4			5	4		5	2	2	
	Constructability reviews	3	2		5	4			4	2		5	2	3	
	Design peer reviews	3	4		5	3			5	5		5	3	3	
	Design standard checks	3	3		5	4			4	4		5	2	3	
	Informal/over-the-shoulder reviews of design in progress with the owner	3	3		3	4			4	5		5	3	2	
	Informal/over-the-shoulder reviews of design in progress with the contractor	3	3		3	4			3	2		4	2	2	
	Trade subconsultant involvement in the design review process	2	4		5	5			3	2		4	2	3	
	Material/equipment supplier involvement in the design review process	2	5		1	5			3	5		4	2	4	

Survey Comments from Respondents

		4569907095	4566840491	4562581418	4560707997	4555087458	4554276682	
	StartDate	9-Mar-16	8-Mar-16	7-Mar-16	6-Mar-16	3-Mar-16	3-Mar-16	
9	If you have used design-build for public projects, please specify which type. Please check all public project types that apply.							
	Other (please specify)		Airport					
10	On what type of projects have you used design-build? Please check all that apply.							
	Other (please specify)			Entertainment and dining pavilion for non-profit organization.		Institutional clients in Higher-Ed, Secondary Ed, Church and faith-based groups, Not for profit healthcare,	Institutional	
17	Please describe any other factors that may affect cost growth in design build projects.	Scope increase			Market conditions. Labor and materials cost and availability	Desired design quality by Owner, and establishing what that is.		
19	Please describe any other factors that may affect time growth in design build projects.				Market conditions. Labor and materials availability	Changes to design and late owner input. Changes in design where price significantly has to change, causing team to move back several steps.		

		4550063914	4549277533	4549148753	4547834412	4547750502	
	StartDate	2-Mar-16	1-Mar-16	1-Mar-16	1-Mar-16	1-Mar-16	
9	If you have used design-build for public projects, please specify which type. Please check all public project types that apply.						
	Other (please specify)						
10	On what type of projects have you used design-build? Please check all that apply.						
	Other (please specify)				Medical		
17	Please describe any other factors that may affect cost growth in design build projects.	Designers padding documents.	Timely owner decisions.	The most important factor is market conditions. The owner needs to listen to the contractor and subcontractors input as it relates to making decisions on certain design and/or materials to avoid locking in pricing for materials with key suppliers. This will prevent unnecessary cost increases due to energy surcharges or premiums due to an increase of activity in the market. Subcontractors are in constant contact with key material suppliers and therefore will know about upcoming price increases well in advance.		Material price fluctuations; design changes	
19	Please describe any other factors that may affect time growth in design build projects.					Design changes	

		4544906457	4537151395	4537128123	4536959613
	StartDate	29-Feb-16	25-Feb-16	25-Feb-16	25-Feb-16
9	If you have used design-build for public projects, please specify which type. Please check all public project types that apply.				
	Other (please specify)			Charter school	
10	On what type of projects have you used design-build? Please check all that apply.				
	Other (please specify)			Charter school	
17	Please describe any other factors that may affect cost growth in design build projects.	Cost growth, decrease very much depends on the Owner. Some Owner's want everything for free, some understand the market better. Owner design reviews may or may not affect cost growth because of this. Contractor review meetings, in my experience, help keep the design in check with costs and tend to be more effective in controlling cost growth by "guiding" the design team through the design by checking price on materials used.	Review time doesn't equal a lower price. Normally people find more cost the more time they are given to review		Growth during construction for lack of complete construction details during design.

19	Please describe any other factors that may affect time growth in design build projects.	Construction time depends a lot on the materials used in the project. Products with longer lead times will affect duration of the project. Contractor meetings with the design team can "guide" these decisions to meet the schedule desired by the Owner. In my experience, Owner meetings do not reduce the construction time, and in fact, tend to increase the schedules because of lack of timely decision making. Again, Owner experience with Design-Build processes make a difference in cost and time.			
21	Please describe any other factors that may affect scope creep in design build projects.	The amount of time a design takes to complete may simply be extended due to cost control methods or cost increases incurred by the construction market. Escalation can obviously affect cost. Effective pricing early in the design process however can take these costs into account which will reduce design durations which allow prices to be "locked in" contractually sooner which manages cost by eliminating escalation factors.			
24	Please list any other factors that are important in design administration for design build projects.	Effective communication there is between the design team, the contractor and the Owner is critical to success of the project. The better you can define this process and assign responsibilities and expectations of all parties, the better the chances of success of the project.			

Importance Index Analysis

	1	2	3	4	5	6	7	8	9	Total	Score	Frequency Q11	Severity Q12	Impor Index
Innovation	0.0357	0.0357	0.1071	0	0.1071	0.1429	0.1071	0.25	0.2143			27.59%	38.89%	10.72944
	1	1	3	0	3	4	3	7	6	28	3.5			
Cost savings	0.2759	0.1379	0.069	0.0345	0.1724	0.1034	0.0345	0.1034	0.069			58.62%	65.89%	38.62407
	8	4	2	1	5	3	1	3	2	29	5.93			
Early cost establishment	0.1	0.4	0.2	0.0333	0.1333	0.0667	0.0333	0.0333	0			68.97%	75.56%	52.11067
	3	12	6	1	4	2	1	1	0	30	6.8			
Reduced schedule	0.2069	0.1724	0.1724	0.069	0	0.1724	0.069	0.0345	0.1034			68.97%	65.89%	45.44357
	6	5	5	2	0	5	2	1	3	29	5.93			
Qualification-based selection of both the designer and the builder	0.0645	0.0323	0.0968	0.1935	0.0645	0.129	0.1935	0.0645	0.1613			41.38%	48.78%	20.18424
	2	1	3	6	2	4	6	2	5	31	4.39			
Single entity responsible for design and construction	0.0714	0.0357	0.2143	0.1786	0.1429	0.0714	0.0714	0.0714	0.1429			55.17%	55.56%	30.65
	2	1	6	5	4	2	2	2	4	28	5			
Builder involvement in the design process	0.1333	0.2	0.0667	0.1333	0.1	0.1333	0.1333	0.0333	0.0667			65.52%	62.56%	40.9864
	4	6	2	4	3	4	4	1	2	30	5.63			
Enhance quality	0.0357	0.0357	0.1071	0.1786	0.1071	0	0.25	0.2857	0			44.83%	47.67%	21.36897
	1	1	3	5	3	0	7	8	0	28	4.29			
Best value selection	0.1724	0.0345	0.069	0.1379	0.1379	0.1379	0.069	0.069	0.1724			44.83%	54.44%	24.40744
	5	1	2	4	4	4	2	2	5	29	4.9			

Managing Cost Growth Analysis

Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total	Weighted Avg
Construction cost growth can be minimized by active collaboration between the designer and the contractor's preconstruction staff during the preparation of the design documents.	0.00%	0.00%	2.86%	20.00%	77.14%	35	4.74
	0	0	1	7	27		
Construction cost growth can be minimized by the early contractor budget input to the designer regarding contract proposal price constraints.	0.00%	0.00%	8.57%	25.71%	65.71%	35	4.57
	0	0	3	9	23		
Construction cost growth can be minimized by timely review and approval by the owner of design documents.	0.00%	2.86%	14.29%	37.14%	45.71%	35	4.26
	0	1	5	13	16		
Construction cost growth decreases as the number of contractor design reviews increase.	0.00%	14.71%	14.71%	52.94%	17.65%	35	3.74
	0	5	5	18	6		
Construction cost growth decreases as the number of owner design reviews increase.	0.00%	22.86%	34.29%	28.57%	14.29%	35	3.34
	0	8	12	10	5		
Construction cost growth goes down as the amount of time to complete the design increases.	5.71%	25.71%	25.71%	28.57%	14.29%	35	3.20
	2	9	9	10	5		

Managing Time Growth Analysis

Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total	Weighted Avg
Construction time growth can be minimized by timely review and approval by the owner of design documents.	0.00%	5.71%	2.86%	25.71%	65.71%	35	4.51
	0	2	1	9	23		
Construction time growth can be minimized by active collaboration between the designer and the contractor's preconstruction staff during the preparation of the design documents.	0.00%	0.00%	2.86%	54.43%	45.71%	35	4.43
	0	0	1	18	16		
Construction time growth can be minimized by the early contractor budget input to the designer regarding contract proposal price constraints.	0.00%	2.86%	11.43%	40.00%	45.71%	35	4.29
	0	1	4	14	16		
Construction time growth decreases as the number of contractor design reviews increase.	0.00%	5.71%	37.14%	42.86%	14.29%	35	3.66
	0	2	13	15	5		
Construction time growth decreases as the number of owner design reviews increase.	0.00%	17.14%	40.00%	31.43%	11.43%	35	3.37
	0	6	14	11	4		
Construction time growth goes down as the amount of time to complete the design increases.	5.71%	17.17%	25.71%	34.29%	17.14%	35	3.40
	2	6	9	12	6		

Managing Scope Creep Growth Analysis

Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total	Weighted Avg
Scope creep risk increases as the number of contractor design reviews decreases.	2.94%	8.82%	8.82%	47.06%	32.35%	34	3.97
	1	3	3	16	11		
Scope creep risk increases as the level of specific design information in the RFP decreases.	5.88%	8.82%	5.88%	47.06%	32.35%	34	3.91
	2	3	2	16	11		
Scope creep risk increases as contractor budget input to the designer regarding contract proposal price constraints decreases.	6.06%	6.06%	15.15%	36.36%	36.36%	33	3.91
	2	2	5	12	12		
Scope creep risk increases as the timeliness of contractor constructability reviews decreases.	9.09%	6.06%	18.18%	39.39%	27.27%	33	3.70
	3	2	6	13	9		
Scope creep risk increases as the amount of time to complete the design increases.	2.94%	26.47%	20.59%	35.29%	14.71%	34	3.32
	1	9	7	12	5		
Scope creep risk increases as the number of owner design reviews increase.	8.82%	17.65%	29.41%	35.29%	8.82%	34	3.18
	3	6	10	12	3		

Stakeholder Design Input Analysis

Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total	Weighted Avg
Early contractor participation is important in design administration for design-build projects.	3.23%	0.00%	3.23%	25.81%	67.74%	31	4.55
	1	0	1	8	21		
Periodic informal (over-the-shoulder) design reviews are important for design administration for design-build projects.	3.23%	0.00%	9.68%	32.26%	54.84%	31	4.35
	1	0	3	10	17		
Appointing a single individual on the design-builder's preconstruction staff as the design manager reduces construction cost growth.	3.23%	3.23%	16.13%	29.03%	48.39%	31	4.16
	1	1	5	9	15		
Appointing a single individual on the design-builder's preconstruction staff as the design manager reduces scope creep risk.	3.23%	3.23%	16.13%	29.03%	48.39%	31	4.16
	1	1	5	9	15		
Building information modeling (BIM) improves the quality of the final design documents.	3.13%	3.13%	21.88%	28.13%	43.75%	32	4.06
	1	1	7	9	14		
Appointing a single individual on the design-builder's preconstruction staff as the design manager improves the quality of the final design documents.	9.68%	3.23%	12.90%	25.81%	48.39%	31	4.00
	3	1	4	8	15		
Appointing a single individual on the design-builder's preconstruction staff as the design manager reduces project time growth.	3.23%	12.90%	29.03%	22.58%	32.26%	31	3.68
	1	4	9	7	10		
BIM reduces construction cost growth.	3.13%	6.25%	46.88%	12.50%	31.25%	32	3.63
	1	2	15	4	10		
BIM reduces project time growth.	3.13%	3.13%	50.00%	15.63%	28.13%	32	3.63
	1	1	16	5	9		
BIM reduces scope creep risk.	3.13%	9.38%	46.88%	15.63%	25.00%	32	3.50
	1	3	15	5	8		

Expectations and Relationships Analysis

Indicate your level of agreement with the following statements regarding design administration goals in design-build projects by checking the appropriate box.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total	Weighted Avg
A cohesive team is important in design administration for design-build projects.	0.00%	0.00%	3.45%	17.24%	79.31%	29	4.76
	0	0	1	5	23		
Early establishment of owner project expectations is important in design administration for design-build projects.	0.00%	0.00%	0.00%	26.67%	73.33%	30	4.73
	0	0	0	8	22		
Early establishment of the design-build team's project expectations is important in design administration for design-build projects	0.00%	0.00%	0.00%	40.00%	60.00%	30	4.60
	0	0	0	12	18		
Establishing a standardized method for technical communication and documentation is important in design administration for design-build projects.	0.00%	0.00%	3.33%	43.33%	53.33%	30	4.50
	0	0	1	13	16		
A formal partnering workshop adds value to the relationships between members of the design-build team and the owner's team.	0.00%	0.00%	6.67%	46.67%	46.67%	30	4.40
	0	0	2	14	14		
A post-award design charrette adds value to the design administration process.	0.00%	0.00%	10.00%	43.33%	46.67%	30	4.37
	0	0	3	13	14		
Setting up digital communications tools such as FTP sites, drop boxes, etc. adds value to the design administration for design-build projects.	0.00%	0.00%	16.67%	36.67%	46.67%	30	4.30
	0	0	5	11	14		
Developing dispute/disagreement escalation ladder between the owner's design review team and the design-build team adds value to the design administration process.	0.00%	0.00%	23.33%	43.33%	33.33%	30	4.10
	0	0	7	13	10		
Developing an internal design-build team dispute/ disagreement escalation ladder adds value to the design administration process.	0.00%	0.00%	30.00%	30.00%	40.00%	30	4.10
	0	0	9	9	12		

Design Reviews Analysis

Indicate the your opinion of the frequency at which the following events should occur during design administration to ensure a final design that meets DB contract scope, cost, and schedule requirements.	Never	Weekly	Bi-Weekly	Monthy	End of Design Phase	Total	Weighted Avg
Building code analysis and reviews	0.00%	6.90%	17.24%	34.48%	41.38%	29	4.10
	0	2	5	10	12		
Design peer reviews	0.00%	0.00%	34.48%	24.14%	41.38%	29	4.07
	0	0	10	7	12		
Design standard checks	0.00%	6.90%	41.38%	27.59%	24.14%	29	3.69
	0	2	12	8	7		
Material/equipment supplier involvement in the design review process	3.45%	13.79%	20.69%	37.93%	24.14%	29	3.66
	1	4	6	11	7		
Owner criteria compliance checks	0.00%	24.14%	20.69%	27.59%	27.59%	29	3.59
	0	7	6	8	8		
Constructability reviews	0.00%	17.24%	34.48%	27.59%	20.69%	29	3.52
	0	5	10	8	6		
Trade subconsultant involvement in the design review process	0.00%	27.59%	24.14%	31.03%	17.24%	29	3.38
	0	8	7	9	5		
Informal/over-the-shoulder reviews of design in progress with the owner	0.00%	20.69%	51.72%	20.69%	6.90%	29	3.14
	0	6	15	6	2		
Informal/over-the-shoulder reviews of design in progress with the contractor	0.00%	37.93%	41.38%	17.24%	3.45%	29	2.86
	0	11	12	5	1		

Managing Cost Growth Variance between Demographics

	16. Cost Growth	16.1	16.2	16.3	16.4	16.5	16.6
Owner Mean Score	2	5.00	4.50	5.00	3.00	3.00	2.00
Dsgn Mean Score	4	4.25	3.75	4.25	3.50	3.00	3.00
DBr Mean Score	19	4.79	4.32	4.68	3.95	3.58	3.11
CM Mean Score	2	4.50	4.00	5.00	3.50	3.00	4.50
Bldr Mean Score	8	4.88	4.38	4.25	3.57	3.13	3.50
Variance btw Owner and Dsgn		0.75	0.75	0.75	-0.50	0.00	-1.00
Variance btw Owner and DBr		0.21	0.18	0.32	-0.95	-0.58	-1.11
Variance btw Owner and CM		0.50	0.50	0.00	-0.50	0.00	-2.50
Variance btw Owner and Bldr		0.13	0.13	0.75	-0.57	-0.13	-1.50
Variance btw Dsgn and DBr		-0.54	-0.57	-0.43	-0.45	-0.58	-0.11
Variance btw Dsgn and CM		-0.25	-0.25	-0.75	0.00	0.00	-1.50
Variance btw Dsgn and Bldr		-0.63	-0.63	0.00	-0.07	-0.13	-0.50
Variance btw DBr and CM		0.29	0.32	-0.32	0.45	0.58	-1.39
Variance btw DBr and Bldr		-0.09	-0.06	0.43	0.38	0.45	-0.39
Variance btw CM and Bldr		-0.38	-0.38	0.75	-0.07	-0.13	1.00

Managing Time Growth Variance between Demographics

	18. Time Growth	18.1	18.2	18.3	18.4	18.5	18.6
Owner Mean Score		4.50	5.00	4.50	3.00	3.00	2.00
Dsgn Mean Score		4.25	3.75	3.75	3.50	3.25	3.75
DBr Mean Score		4.47	4.68	4.26	3.79	3.47	3.47
CM Mean Score		4.00	5.00	4.50	3.00	3.00	3.50
Bldr Mean Score		4.50	4.25	4.50	3.75	3.38	3.38
Variance btw Owner and Dsgn		0.25	1.25	0.75	-0.50	-0.25	-1.75
Variance btw Owner and DBr		0.03	0.32	0.24	-0.79	-0.47	-1.47
Variance btw Owner and CM		0.50	0.00	0.00	0.00	0.00	-1.50
Variance btw Owner and Bldr		0.00	0.75	0.00	-0.75	-0.38	-1.38
Variance btw Dsgn and DBr		-0.22	-0.93	-0.51	-0.29	-0.22	0.28
Variance btw Dsgn and CM		0.25	-1.25	-0.75	0.50	0.25	0.25
Variance btw Dsgn and Bldr		-0.25	-0.50	-0.75	-0.25	-0.13	0.38
Variance btw DBr and CM		0.47	-0.32	-0.24	0.79	0.47	-0.03
Variance btw DBr and Bldr		-0.03	0.43	-0.24	0.04	0.10	0.10
Variance btw CM and Bldr		-0.50	0.75	0.00	-0.75	-0.38	0.13

Managing Scope Creep Variance between Demographics

	20. Scope Creep	20.1	20.2	20.3	20.4	20.5	20.6
Owner Mean Score		4.00	4.00	4.00	4.50	3.00	3.50
Dsgn Mean Score		3.00	2.50	3.33	3.75	3.50	3.25
DBr Mean Score		4.00	4.06	4.17	4.22	3.28	3.50
CM Mean Score		4.00	2.50	2.50	3.00	2.50	3.00
Bldr Mean Score		4.13	3.75	3.88	3.63	3.00	3.00
Variance btw Owner and Dsgn		1.00	1.50	0.67	0.75	-0.50	0.25
Variance btw Owner and DBr		0.00	-0.06	-0.17	0.28	-0.28	0.00
Variance btw Owner and CM		0.00	1.50	1.50	1.50	0.50	0.50
Variance btw Owner and Bldr		-0.13	0.25	0.13	0.88	0.00	0.50
Variance btw Dsgn and DBr		-1.00	-1.56	-0.83	-0.47	0.22	-0.25
Variance btw Dsgn and CM		-1.00	0.00	0.83	0.75	1.00	0.25
Variance btw Dsgn and Bldr		-1.13	-1.25	-0.54	0.13	0.50	0.25
Variance btw DBr and CM		0.00	1.56	1.67	1.22	0.78	0.50
Variance btw DBr and Bldr		-0.13	0.31	0.29	0.60	0.28	0.50
Variance btw CM and Bldr		-0.13	-1.25	-1.38	-0.63	-0.50	0.00

Expectations and Relationships Variance between Demographics

22. Expectations	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9	22.91
Owner Mean Score	5.00	5.00	5.00	5.00	5.00	5.00	4.00	4.00	4.00	3.50
Dsgn Mean Score	4.33	3.33	3.67	3.67	3.00	4.00	3.67	3.33	3.33	3.33
DBr Mean Score	4.71	4.59	4.24	4.65	3.88	4.53	4.41	3.94	3.88	3.94
CM Mean Score	5.00	4.50	4.50	3.50	4.00	4.00	4.50	4.00	4.00	3.00
Bldr Mean Score	4.13	4.13	3.38	3.38	3.25	3.38	3.38	2.88	3.00	2.75
Variance btw Owner and Dsgn	0.67	1.67	1.33	1.33	2.00	1.00	0.33	0.67	0.67	0.17
Variance btw Owner and DBr	0.29	0.41	0.76	0.35	1.12	0.47	-0.41	0.06	0.12	-0.44
Variance btw Owner and CM	0.00	0.50	0.50	1.50	1.00	1.00	-0.50	0.00	0.00	0.50
Variance btw Owner and Bldr	0.88	0.88	1.63	1.63	1.75	1.63	0.63	1.13	1.00	0.75
Variance btw Dsgn and DBr	-0.37	-1.25	-0.57	-0.98	-0.88	-0.53	-0.75	-0.61	-0.55	-0.61
Variance btw Dsgn and CM	-0.67	-1.17	-0.83	0.17	-1.00	0.00	-0.83	-0.67	-0.67	0.33
Variance btw Dsgn and Bldr	0.21	-0.79	0.29	0.29	-0.25	0.63	0.29	0.46	0.33	0.58
Variance btw DBr and CM	-0.29	0.09	-0.26	1.15	-0.12	0.53	-0.09	-0.06	-0.12	0.94
Variance btw DBr and Bldr	0.58	0.46	0.86	1.27	0.63	1.15	1.04	1.07	0.88	1.19
Variance btw CM and Bldr	0.88	0.38	1.13	0.13	0.75	0.63	1.13	1.13	1.00	0.25

Stakeholder Design Input Variance between Demographics

23. Stakeholder	23.1	23.2	23.3	23.4	23.5	23.6	23.7	23.8	23.9
Owner Mean Score	5.00	4.50	5.00	4.00	3.50	5.00	4.50	4.50	4.00
Dsgn Mean Score	4.00	4.00	4.33	4.00	3.67	4.67	4.00	3.00	3.00
DBr Mean Score	4.88	4.76	4.53	4.71	4.41	4.82	4.65	4.35	4.47
CM Mean Score	5.00	4.50	3.50	4.00	4.50	4.50	3.50	3.50	3.00
Bldr Mean Score	4.50	4.50	4.00	4.50	4.50	4.67	4.17	4.00	4.00
Variance btw Owner and Dsgn	1.00	0.50	0.67	0.00	-0.17	0.33	0.50	1.50	1.00
Variance btw Owner and DBr	0.12	-0.26	0.47	-0.71	-0.91	0.18	-0.15	0.15	-0.47
Variance btw Owner and CM	0.00	0.00	1.50	0.00	-1.00	0.50	1.00	1.00	1.00
Variance btw Owner and Bldr	0.50	0.00	1.00	-0.50	-1.00	0.33	0.33	0.50	0.00
Variance btw Dsgn and DBr	-0.88	-0.76	-0.20	-0.71	-0.75	-0.16	-0.65	-1.35	-1.47
Variance btw Dsgn and CM	-1.00	-0.50	0.83	0.00	-0.83	0.17	0.50	-0.50	0.00
Variance btw Dsgn and Bldr	-0.50	-0.50	0.33	-0.50	-0.83	0.00	-0.17	-1.00	-1.00
Variance btw DBr and CM	-0.12	0.26	1.03	0.71	-0.09	0.32	1.15	0.85	1.47
Variance btw DBr and Bldr	0.38	0.26	0.53	0.21	-0.09	0.16	0.48	0.35	0.47
Variance btw CM and Bldr	0.50	0.00	-0.50	-0.50	0.00	-0.17	-0.67	-0.50	-1.00

Design Reviews Variance between Demographics

25. Design Reviews	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9
Owner Mean Score	5.00	5.00	5.00	3.00	3.00	2.00	2.00	4.00	4.00
Dsgn Mean Score	3.67	5.00	4.00	4.67	4.00	3.33	3.67	3.67	3.67
DBr Mean Score	3.31	4.13	3.44	4.06	3.59	3.06	2.65	3.00	3.41
CM Mean Score	4.00	4.00	4.00	3.50	3.50	3.50	3.50	4.50	5.00
Bldr Mean Score	4.60	4.20	4.00	4.17	4.40	3.33	3.20	3.83	3.83
Variance btw Owner and Dsgn	1.33	0.00	1.00	-1.67	-1.00	-1.33	-1.67	0.33	0.33
Variance btw Owner and DBr	1.69	0.88	1.56	-1.06	-0.59	-1.06	-0.65	1.00	0.59
Variance btw Owner and CM	1.00	1.00	1.00	-0.50	-0.50	-1.50	-1.50	-0.50	-1.00
Variance btw Owner and Bldr	0.40	0.80	1.00	-1.17	-1.40	-1.33	-1.20	0.17	0.17
Variance btw Dsgn and DBr	0.35	0.88	0.56	0.61	0.41	0.27	1.02	0.67	0.25
Variance btw Dsgn and CM	-0.33	1.00	0.00	1.17	0.50	-0.17	0.17	-0.83	-1.33
Variance btw Dsgn and Bldr	-0.93	0.80	0.00	0.50	-0.40	0.00	0.47	-0.17	-0.17
Variance btw DBr and CM	-0.69	0.13	-0.56	0.56	0.09	-0.44	-0.85	-1.50	-1.59
Variance btw DBr and Bldr	-1.29	-0.08	-0.56	-0.11	-0.81	-0.27	-0.55	-0.83	-0.42
Variance btw CM and Bldr	-0.60	-0.20	0.00	-0.67	-0.90	0.17	0.30	0.67	1.17

APPENDIX D

STRUCTURED INTERVIEWS

Structured Interview Questionnaire

CONDITIONS: This interview can either be conducted in person or via telephone. The following protocol shall be followed during its administration:

1. The interview appointment will be set with the interviewee,
2. One day prior to the interview, a follow-up message with the questionnaire attached will be sent to confirm the date and time of the interview.
3. The interviewer will set the stage with a brief introduction that emphasizes the purpose of the research, the type of information expected to be collected, and the ground rules for the interview.
4. Once the interviewee indicates that they understand the process at hand, the interview will commence.
5. The interviewer will read each question then ask the interviewee to respond.
6. Each question contains a specific response that must be obtained before moving to the next question. Once that response is obtained, the interviewer can record as text additional cogent information that may have been discussed by the interviewees in working their way to the specific response.
7. Upon conclusion of the interview, the interviewer will ask the interviewees if they have additional information that they would like to contribute and record those answers as text.
8. The interviewer will assemble a clean copy of the final interview results and return them to the interviewee for verification.

I. General Information:

1. Date and Time:

   March 9, 2016 at 5:00 pm

2. City and state in which the respondent is employed:

   Dallas, Texas

3. Company:

   JE Dunn; Project Manager

4. What type of organization do you work for?

   ☐ Owner ☐ Design Professional ☐ Builder ☐ Design-Builder

   ☒ Construction Manager ☐ Other; Please describe:

5. Public or Private:

   Private

6. Number of professional design/construction staff:

   1500 in company, 80 in Dallas

7. What capabilities does your organization have? Please check all that apply.

   ☐ In-house design ☒In-house construction ☒ In-house contract administration

8. Average annual volume:

   In Dallas – $100 million

9. Average annual number of projects:

   In Dallas – 6 per year

10. Project monetary size range:

    $1 million up to $100 million

11. Average monetary size of a typical project:

    $20 million

II. Design-Build Experience:

12. Do you have previous design-build experience?

    ☒ Yes ☐ No

13. How many projects have you used design-build?

    Three (3) projects

14. In what sectors have you used the design-build delivery method?

☐ Public Only ☐ Private Only ☒ Both ☐ NA

Two (2) private, One (1) hybrid (municipality)

15. If you have used design-build for public projects, please specify which type. Please check all public project types that apply.

☐ Federal ☐ State ☒ Other, please specify: Municipality ☐ NA

16. On what type of projects have you used design-build? Please check all that apply.

☒ Commercial ☐ Industrial ☐ Heavy Highway ☐ Residential

☒ Other; Please describe: Education, hospitality, and office ☐ NA

III. Design Administration in Design-Build:

1. In your design-build experience, please describe the primary cause of cost growth in projects.

Not understanding the owner expectations / Not ensuring we get owner expectations correct before we go to GMP.

Not managing deadline of design timetable – more cost is associated with more schedule/time.

1a. How can it be mitigated?

Use an outline specification to clarify the owner's expectations. Utilize target value design. Such as: What's driving the project?

Things can be missed in the outline spec, so communication with what the owner wants is important.

Partnering session (team building) – use a day-long organized meeting to understand each other, get to know owner, what does he/she want, what is he trying to maximize.

2. In your design-build experience, please describe the primary cause of schedule growth in projects.

Owner or designer not meeting deadlines. Construction Manager is only one motivated by time during the delivery of a project (unless the owner is being pushed by client).

2a. How can it be mitigated?

In my current project, we are ahead of schedule and it did not grow because I managed our owner by giving him clear deadlines and holding him accountable at deadlines. I call it "healthy accountability."

3. In your design-build experience, please describe the primary cause of scope creep in projects.

    Similar to cost growth.

3a. How can it be mitigated?

    Checking in/design reviews – helps the designer stay focused and on target. Keep a healthy level of communication with design team is also important to keep designer on task.

    Open communication.

    Construction managers are often looked at by owners as design managers, then we get in trouble for design creep.

4. Survey says: Construction cost, time growth, and scope creep risk decreases as the amount of time to complete the design increases.

    Literature says: Timely and accurate production documents results in a successful design-build project (success = meets budget, schedule, and quality requirements).

    What motivators / factors aid in timely and accurate production of construction documents?

    Maybe fee… more money. The most important thing to most architects is the quality of design, and wanting to give as much influence and ability to affect in the final project. Prestige is as important as profit.

    The more time an architect has to draw, the more creative and more things they will include that is not within the design intent.

    4a. Design level of completion is subjective. Do you have recommendations how to make the levels of design (schematic, conceptual, design development, and construction) more concrete?

    I would like to get away from use of "percentage complete" in design altogether.

5. Do you have experience working with a design manager? What are the pros and cons?

    No; I would challenge the idea of having it on a design build project. A program manager would be qualified as a design manager.

6. Survey says: Early establishment of owner and design-build team's project expectations is important in design administration for design-build projects.

    A post-award design charrette adds value to the design administration process.

    Literature says: An early establishment of roles and responsibilities aids in the design administration process.

    In your experience or in your company, what are the best practices for starting a design-build project? Do you have a set of guidelines to follow?

Fundamentally, a partnering session is a good start. There is often an inherent dysfunction between construction manager and designer. Set expectations.

There are pros and cons to have a more soft, squishy meeting (no agenda) than a more structured meeting.

It's better to build a personal relationship, than business relationship. Building a relationship outside of the confines of the project and respecting the roles of the team. By emphasizing what is important to other people and learning it will let you help him (designer) accomplish his goal. And that helps him (designer) help you.

7. Design reviews with stakeholders, contractors, and subs are important in mitigating cost growth, time growth, and scope creep risk.

   What is your opinion on the frequency of design reviews? When is it productive? When is it not?

   It's contingent of type of projects. There is value to a structured review with client and team. If it's a one year design schedule, once a month is good. But if the design schedule is shorter such as NTP to CDs schedule is 3 months, it is hard to meet a lot of times.

   Set targeted meetings then have entire team do a drawing flip to call out issues.

   Check-in in points are good to make sure within bumpers of what owner wants.

   DB team needs to be within walk step of each other.

   Additional comments:

   Trying to get into agreement stage (i.e. what is the budget) is the hard part. I've had less trouble maintaining budget than maintaining schedule.

I. General Information:

1. Date and Time:

   March 10, 2016 at 5:25 pm

2. City and state in which the respondent is employed:

Dallas, TX

3. Company:

Trammell Crow Company

4. What type of organization do you work for?

☒ Owner ☐ Design Professional ☐ Builder ☐ Design-Builder

☐ Construction Manager ☒Other; Please describe: Commercial Developer

5. Public or Private:

Public

6. Number of professional design/construction staff:

Six (6) locally (DFW) but considerably more among the fourteen (14) offices nationwide.

7. What capabilities does your organization have? Please check all that apply.

☐ In-house design ☐ In-house construction ☒ In-house contract administration

8. Average annual volume:

   National #1 development company in 2015, $6.7 billion worth of projects in process, approximately 140 projects

   $2.8 billion in offices, $1.7 billion in industrial, $1.3 billion in multi-family, $900 million in miscellaneous projects

9. Average annual number of projects:

   Depends on supply and demand

10. Project monetary size range:

    Roughly $20 to $300 million plus our project values typically refer to total development costs of which hard costs generally represent 65% - 80% depending upon land value, commission structure, etc.

11. Average monetary size of a typical project:

    Varies dramatically by product type and deal specifics

II. Design-Build Experience:

12. Do you have previous design-build experience?

    ☐ Yes ☒ No

    "Design-Build cuts me out."

13. How many projects have you used design-build?

NA

14. In what sectors have you used the design-build delivery method?

☐ Public Only ☐ Private Only ☐ Both ☒ NA

15. If you have used design-build for public projects, please specify which type. Please check all public project types that apply.

☐ Federal ☐ State ☐ Other, please specify: ☒ NA

16. On what type of projects have you used design-build? Please check all that apply.

☐ Commercial ☐ Industrial ☐ Heavy Highway ☐ Residential

☐ Other; Please describe: ☒ NA

III. Design Administration in Design-Build:

1. In your design-build experience, please describe the primary cause of cost growth in projects.

    a. Owner decision making

    b. Design ambition

    c. Lack of coordination and communication as it relates to constructability

1a. How can it be mitigated?

    a. Mitigated by a single-source contact. Regardless of delivery model, there needs to be clear chain of command and hierarchy of communication. You can't have 50 people talking to each other.

    b. Architects like to draw pretty things and expensive things. Have to keep them on task.

    c. There should be on-going dialogue between design and construction team.

    No matter how much technology improves, you can never replace human interface. You have to have people talk to each other.

2. In your design-build experience, please describe the primary cause of schedule growth in projects.

    Again, owner decision-making.

2a. How can it be mitigated?

    Architect has to know what expectations are. Set expectation of the design vision early – What's the business model behind it? Who are you competing with? What's the cost structure? You don't always want to show budget in the beginning because it can go up from there.

Then following through from an accountability perspective. You need to afford the designer an appropriate amount of time to do job, but they need to be accountable to do it.

3. In your design-build experience, please describe the primary cause of scope creep in projects.

   a. Owner decision making

   b. Owner ambitions

   c. Design autonomy

3a. How can it be mitigated?

4. Survey says: Construction cost, time growth, and scope creep risk decreases as the amount of time to complete the design increases.

   Literature says: Timely and accurate production documents results in a successful design-build project (success = meets budget, schedule, and quality requirements).

What motivators / factors aid in timely and accurate production of construction documents?

The more time you give them (architects) to design, the more bad things happen. Time isn't used productively because it gives them more time to make decisions that aren't value based.

"What else can we add? This would be great!"

Communicate throughout the design and assess what they are drawing.

Hold the designer accountable. Give the designer an understanding of their role in context to the overall team and delivering their expectations in association with the business model. Must meet timetables.

4a. Design level of completion is subjective. Do you have recommendations how to make the levels of design more concrete?

It gets gray between conceptual to DD. I have seen matrixes that show what the design should show. The owner relies on contractor help you understand what's going on in the levels of design.

Ensure the level of definition in continuity with the scope definition, but details are becoming better enhanced.

Use contractor as a meter to know how good the drawings are. Use the contractor as a fire alarm to let him know the architect isn't doing a good job.

People that are accountable, highly-qualified, and can communicate will bring success to a project.

5. Do you have experience working with a design manager? What are the pros and cons?

Refer to above with have one go-to person. Single source contact is good.

Cons- Inherent stress on the individual. While the goal is to make everyone happy, but sometimes has to play the bad cop.

6. Survey says: Early establishment of owner and design-build team's project expectations is important in design administration for design-build projects.

   A post-award design charrette adds value to the design administration process.

   Literature says: An early establishment of roles and responsibilities aids in the design administration process.

   In your experience or in your company, what are the best practices for starting a design-build project? Do you have a set of guidelines to follow?

   Must have a good business model in place. What are we building? Do we have the right budget? Fundamentally, a sound business model and appropriate budget should be set in the beginning.

   Surrounding yourself with qualified people—that's why we go with select bid lists. We go with firms that we have good relationships with and good experiences with to have a good level of trust.

   Talking with contractors for feedback on typical costs and schedule implications of an evolving projects.

7. Design reviews with stakeholders, contractors, and subs are important in mitigating cost growth, time growth, and scope creep risk.

   What is your opinion on the frequency of design reviews? When is it productive? When is it not?

   Best a design milestones –

   If you have to redirect during the design, then you may want to add intermediate design reviews.

   The more complex, the more incremental milestones.

   Beyond that, set up artificial milestones depending on complexity. Make time for some breakout sessions that may affect cost or schedule later one.

Additional comments:

DB is better for projects where owner isn't as experienced at managing themselves.

I. General Information:

1. Date and Time:

   March 11, 2016 at 10:02 am

2. City and state in which the respondent is employed:

   Dallas, TX

3. Company:

   dba The Beck Group. Ownership is HCBeck, Ltd. and architecture practice is under Beck Architecture, LLC

4. What type of organization do you work for?

☐ Owner ☐ Design Professional ☐ Builder ☒ Design-Builder

☐ Construction Manager ☐ Other; Please describe:

5. Public or Private:

   Private

6. Number of professional design/construction staff:

   Approximately 730

7. What capabilities does your organization have? Please check all that apply.

☒ In-house design ☒ In-house construction ☒ In-house contract administration

8. Average annual volume:

   $1.3 billion

9. Average annual number of projects:

   Unsure

10. Project monetary size range:

    $15 million to $350 million

11. Average monetary size of a typical project:

    $20-25 million

II. Design-Build Experience:

12. Do you have previous design-build experience?

☒ Yes ☐ No

13. How many projects have you used design-build?

    Hundreds

14. In what sectors have you used the design-build delivery method?

☐ Public Only ☐ Private Only ☒Both ☐ NA

15. If you have used design-build for public projects, please specify which type. Please check all public project types that apply.

☒ Federal ☒ State ☐ Other, please specify: ☐ NA

16. On what type of projects have you used design-build? Please check all that apply.

☒Commercial ☐ Industrial ☐ Heavy Highway ☒Residential

☒Other; Please describe: Healthcare, Faith-based and Higher-Ed ☐ NA

III. Design Administration in Design-Build:

1. In your design-build experience, please describe the primary cause of cost growth in projects.

> Cost growth for us, on our internally managed design-build projects, occurs when the owner adds to the program scope or starts the project without a clear definition of the expected or desired outcomes. This could be through ignorance on the owner's part or a willful avoidance of doing what needs to be done to make things clear.
>
> Cost growth from a client's perspective is different than on contractor side. Our company puts together a "GMP" at schematic level, though it's not called a GMP. As a DBer, we know when something is supposed to be in the project. We deliver a true price over a fable price delivered by a competitor. We try to anticipate what the owner wants as much as possible at the front end, but sometimes owner changes throughout the design.

1a. How can it be mitigated?

> We specify and mandate A/E/C/Owner expectation meetings at the outset of every project, before design even begins.

2. In your design-build experience, please describe the primary cause of schedule growth in projects.

> Schedule growth for us only occurs from uncontrollable factors outside Beck's contractual control. Unknown conditions, owner changes, lack of good sub-contractor agreements early in process.
>
> Owner can be his own worst enemy. If owner is driven by time and needs the project delivered by a certain date, we can help him get there with sacrifices, and he may not like that. Owners want the best of everything, but with the best of everything we can't meet schedule. There is a balance between cost, schedule, and quality.

2a. How can it be mitigated?

Early planning and early purchasing to prevent time growth. Committing early to subs helps too.

3. In your design-build experience, please describe the primary cause of scope creep in projects.

Same as cost growth, scope creep drives price.

3a. How can it be mitigated?

4. Survey says: Construction cost, time growth, and scope creep risk decreases as the amount of time to complete the design increases.

Literature says: Timely and accurate production documents results in a successful design-build project (success = meets budget, schedule, and quality requirements).

What motivators / factors aid in timely and accurate production of construction documents?

Internally, fee for design is 5%, and construction fee is 3%, we try to get 15% profit, we need more man hours to produce accurate documents. It saves errors. Decreases cost because less uncertainty.

Owners aren't sophisticated enough to know acceptability of level of drawings.

Jobs for architects are more demanding, BIM allows us to do more but it takes more time.

Motivators: Pride in design. Accountability to be better than competitor. Withholding pay, would start fighting relationships.

Get involved early in the design process. Establish common expectations and goals, and get into a detailed discussion what is needed, and try to help architect be more efficient.

When arch doesn't have a relationship with contractor, they don't care about level of drawings.

4a. Design level of completion is subjective. Do you have recommendations how to make the levels of design more concrete?

Not all architects put out same level of drawings, BIM has changed a lot of things and make things more set. For instance, before BIM, we could easily draft a detail requested by the contractor. But with BIM, we have to build the whole model before being able to extract details. Developing drawings is different. It blends into 30, 60, 90%. Architects are producing less because BIM is requiring them to put info where they don't have time to put.

Our company has evolved a process where we must be co-located, a construction manager needs to be involved from the beginning and working with the design. – integrated project leader (he makes sure schedule is being met on design side).

The construction manager helps designer push out design by suggesting subs to produce details (i.e. curtain wall sub will have shop drawings be final CD drawings).

5. Do you have experience working with a design manager? What are the pros and cons?

   Design itself is managed by design leader and construction is managed by construction leader.

   Note: there can be conflict between design leader and contractor mgr

6. Survey says: Early establishment of owner and design-build team's project expectations is important in design administration for design-build projects.

   A post-award design charrette adds value to the design administration process.

   Literature says: An early establishment of roles and responsibilities aids in the design administration process.

   In your experience or in your company, what are the best practices for starting a design-build project? Do you have a set of guidelines to follow?

   Have a project expectations meeting with owner and common goals. Also need to have a teaming collaboration with internal team so that we understand each other. If team doesn't feel aligned it will show up later in project.

   Co-location: offices the design leader and construction manager next to each other on a project which creates an immediate answer to all parties back and forth.

7. Design reviews with stakeholders, contractors, and subs are important in mitigating cost growth, time growth, and scope creep risk.

   What is your opinion on the frequency of design reviews? When is it productive? When is it not?

   Constructability and pricing reviews should be held when another level of completeness is reached—end of design stage(schematic, DD, 50% CD, and 100% CD).

I. General Information:

1. Date and Time:

   March 14, 2016 at 11:00 am

2. City and state in which the respondent is employed:

   Dallas, TX

3. Company:

   The Beck Group

4. What type of organization do you work for?

☐ Owner ☒ Design Professional ☒ Builder ☒ Design-Builder

☒ Construction Manager ☐ Other; Please describe:

5. Public or Private:

   Private

6. Number of professional design/construction staff:

   TBD

7. What capabilities does your organization have? Please check all that apply.

☒ In-house design ☒ In-house construction ☒ In-house contract administration

8. Average annual volume:

   Varies by discipline and region

9. Average annual number of projects:

   TBD

10. Project monetary size range:

    Up to $300M

11. Average monetary size of a typical project:

    TBD

II. Design-Build Experience:

12. Do you have previous design-build experience?

    ☒ Yes ☐ No

13. How many projects have you used design-build?

    One

14. In what sectors have you used the design-build delivery method?

☐ Public Only ☒ Private Only ☐ Both ☐ NA

15. If you have used design-build for public projects, please specify which type. Please check all public project types that apply.

☐ Federal ☐ State ☐ Other, please specify: ☒ NA

16. On what type of projects have you used design-build? Please check all that apply.

☒ Commercial ☐ Industrial ☐ Heavy Highway ☐ Residential

☐ Other; Please describe: ☐ NA

III. Design Administration in Design-Build:

1. In your design-build experience, please describe the primary cause of cost growth in projects.

No design refinement, expanding scope or changing scope through owner changes. Lack of early programming with owner.

1a. How can it be mitigated?

Mitigated by having very well defined cost per square foot, allowances, and having designer work towards those and collaborating with precon group. Communication is very important.

Mitigating owner changes happens by setting up early programming and expectations, to diminish ambiguity. Can't stop an owner to change stuff, you have to try to mitigate cost increase, make the owner aware of impact on project.

2. In your design-build experience, please describe the primary cause of schedule growth in projects.

Owner and design delays. Often when the design reaches 100% DD, the schedule is set.

We once left a hole in slab because owner couldn't decide on equipment room.

2a. How can it be mitigated?

To ensure continuum of design, get owner decisions made to not miss design target dates. Make sure people are doing their jobs (accountability).

We have a design team leader (integrated project leader/IPL) – to make sure process keeps moving and clears any road blocks. He is the ultimate decision maker.

Have a strong programming phase with the owner to understand what they're looking for.

3. In your design-build experience, please describe the primary cause of scope creep in projects.

   Similar to cost growth.

3a. How can it be mitigated?

4. Survey says: Construction cost, time growth, and scope creep risk decreases as the amount of time to complete the design increases.

   Literature says: Timely and accurate production documents results in a successful design-build project (success = meets budget, schedule, and quality requirements).

   What motivators / factors aid in timely and accurate production of construction documents?

   Owners holding design team accountable. Some owners know what quality SD and DD set looks like and will hold them to that expectation, and other owners are more hands-off. The good thing about DB is preconstruction professionals will give feedback to designers on quality of documents.

4a. Design level of completion is subjective. Do you have recommendations how to make the levels of design more concrete?

   AIA has recommendations but those aren't always followed– to true it up requires setting a level of expectation in the contract phase by telling the designer the owner wants to see this level of detail and holding the designer accountable to that.

5. Do you have experience working with a design manager? What are the pros and cons?

   IPL is like a design manager – involved individual, but not actually working on drawings, can have various background (architecture or construction)

   Pro –Need someone that's not nose down in docs and can see it from a higher level to analyze documents from a new perspective. Someone needs to be designated as a team leader for both design and construction to make decisions and hold them accountable.

   Con – make sure person in that position is a good manager of people and processes

6. Survey says: Early establishment of owner and design-build team's project expectations is important in design administration for design-build projects.

   A post-award design charrette adds value to the design administration process.

   Literature says: An early establishment of roles and responsibilities aids in the design administration process.

   In your experience or in your company, what are the best practices for starting a design-build project? Do you have a set of guidelines to follow?

Our design group has a road map – design continuum – that goes through all parts and pieces they need to consider and handle throughout design phases.

7. Design reviews with stakeholders, contractors, and subs are important in mitigating cost growth, time growth, and scope creep risk.

   What is your opinion on the frequency of design reviews? When is it productive? When is it not?

   Regarding design reviews – overkill is bad. Bi-weekly with owner, but weekly internal. Have design group and precon group sit together (co-location) – helps with pricing updates. Frequency of collaboration needs to be constant . You want the design and precon group to constantly be talking and discussing and working details out.

Additional comments:

Biggest thing is cohesion of team and trust and capabilities.

I. General Information:

1. Date and Time:

   March 15, 2016 at 1:00 pm

2. City and state in which the respondent is employed:

   Dallas, Texas

3. Company:

   The Beck Group

4. What type of organization do you work for?

☐ Owner ☐ Design Professional ☐ Builder ☒ Design-Builder

☒ Construction Manager ☐ Other; Please describe:

5. Public or Private:

   Private

6. Number of professional design/construction staff:

   About 700

7. What capabilities does your organization have? Please check all that apply.

☒ In-house design ☒ In-house construction ☒ In-house contract administration

8. Average annual volume:

   $1.3 billion

9. Average annual number of projects:

   Not sure.

10. Project monetary size range:

    $20 to $300 million

11. Average monetary size of a typical project

    About $25 million

II. Design-Build Experience:

12. Do you have previous design-build experience?

    ☒ Yes ☐ No

13. How many projects have you used design-build?

5-10

14. In what sectors have you used the design-build delivery method?

☐ Public Only ☐ Private Only ☒ Both ☐ NA

Mostly private

15. If you have used design-build for public projects, please specify which type. Please check all public project types that apply.

☒ Federal ☐ State ☐ Other, please specify: With GSA out of Washington DC ☐ NA

16. On what type of projects have you used design-build? Please check all that apply.

☒ Commercial ☐ Industrial ☐ Heavy Highway ☐ Residential

☐ Other; Please describe: ☐ NA

III. Design Administration in Design-Build:

1. In your design-build experience, please describe the primary cause of cost growth in projects.

Lack of up-front coordination and pre-planning. Not making sure you are on the same page with the client which may cause re-work or re-drawings.

1a. How can it be mitigated?

Getting input from the designer and owner throughout the design.

2. In your design-build experience, please describe the primary cause of schedule growth in projects.

Pre-planning

2a. How can it be mitigated?

Early identification of market conditions; getting long-lead materials and equipment early; getting subs on early. Getting input from contractor allows you to get real values and time frames for projects.

3. In your design-build experience, please describe the primary cause of scope creep in projects.

Same as question 1.

3a. How can it be mitigated?

4. Survey says: Construction cost, time growth, and scope creep risk decreases as the amount of time to complete the design increases.

Literature says: Timely and accurate production documents results in a successful design-build project (success = meets budget, schedule, and quality requirements).

What motivators / factors aid in timely and accurate production of construction documents?

As contractors, we see that the quality of documents are not as good as we want. Designers are under same pressure, the designer is squeezing their fee. Designer tries to push to the contractor to finish details in the field.

Driven by reputation and accountability.

Usually run out of time.

Don't squeeze fees and be efficient with time.

4a. Design level of completion is subjective. Do you have recommendations how to make the levels of design more concrete?

Collaborative work at the beginning so there is no rework.

5. Do you have experience working with a design manager? What are the pros and cons?

Integrated project leader –

Pros: Ultimate responsible person to make decisions that will benefit the project and the client in terms of cost, schedule, and quality.

Cons: None.

6. Survey says: Early establishment of owner and design-build team's project expectations is important in design administration for design-build projects.

A post-award design charrette adds value to the design administration process.

Literature says: An early establishment of roles and responsibilities aids in the design administration process.

In your experience or in your company, what are the best practices for starting a design-build project? Do you have a set of guidelines to follow?

Follow a reference manual for design-build so all processes and procedures are the same across the board for each DB project.

7. Design reviews with stakeholders, contractors, and subs are important in mitigating cost growth, time growth, and scope creep risk.

What is your opinion on the frequency of design reviews? When is it productive? When is it not?

If Beck is working with a third-party architect; they have a policy to review each design trade (structural, MEP, architectural) with a subconsultant. Will flush out any inefficiencies or oversights. Good to have two sets of eyes.

Based on pace and size of project, usually at each of each design phase.