GEORGIA DOT RESEARCH PROJECT 19-09

FINAL REPORT

ENTRUSTED ENGINEER-IN-CHARGE: A NEW CRITICAL POSITION IN THE DESIGN–BUILD TEAM

OFFICE OF PERFORMANCE-BASED MANAGEMENT AND RESEARCH

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16. Abstract
One of the main challenges that state departments of transportations (state DOTs) face in their design–build (DB) projects is to ensure that the design–build team upholds the highest standard of care in making complex engineering decisions involving multidisciplinary works. It is crucial to understand the underpinnings of engineering-related problems during both the design and construction phases and identify an effective approach to address these issues in the innovative delivery environment. This research aims to help the Georgia DOT (GDOT) Office of Innovative Delivery clearly define its expectations for the new position of project chief engineer (PCE). The overarching goal of this research project is to identify best practice guidance for defining GDOT's expectations from the design–build team in proactive management of design-related issues. This study identifies gaps between GDOT's expectations and the industry understanding of the PCE's roles and responsibilities. Several emerging challenges related to the successful implementation of the new PCE position are discussed in the context of the dynamic design–build transportation market. The research team conducted content analysis and interviewed various professional groups, including state DOT officers, highway contractors, design consultants, owner's representatives, legal experts, and insurance experts. To further discuss any issues related to insurability, the research team conducted a separate set of interviews with the insurance experts. The results show that, overall, interviewees agree that the PCE will add value for large and complex projects requiring multidisciplinary parties. The PCE requires a unique set of skills both in design and construction, and, therefore, finding an appropriate pool of candidates for the PCE position may be challenging for design–build teams. Several recommendations are made to enhance the description of the PCE role and responsibilities, in order to minimize any gaps in the understanding of the design–build industry professionals to fulfill this position. Not limited to the PCE position introduced by GDOT, the findings contribute to the DB and public–private partnership (P3) market to better understand the engineering decision-making process for the large and complex DB and P3 projects.

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GDOT Research Project 19-09

Final Report

ENTRUSTED ENGINEER-IN-CHARGE: A NEW CRITICAL POSITION IN THE DESIGN–BUILD TEAM

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Contract with
Georgia Department of Transportation

In cooperation with

U.S. Department of Transportation
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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

One of the main challenges that state departments of transportation (DOTs) face in their design–build (DB) projects is to ensure that the design–build team upholds the highest standard of care in making complex engineering decisions involving multidisciplinary works. In addition, during the construction phase of the project, all critical decisions, such as moving traffic to a temporary shoulder and other engineering issues related to temporary structures, must be made with direct inputs and the approval of a professional engineer licensed in the state. Thus, it is crucial to understand the underpinnings of engineering-related problems during both the design and construction phases and identify an effective approach to address these issues in the innovative delivery environment. This research aims to help the Georgia DOT (GDOT) Office of Innovative Delivery clearly define its expectations for the new position of project chief engineer (PCE).

The overarching goal of this research project is to identify best practice guidance on defining GDOT's expectations from the design–build team in proactive management of design-related issues in the innovative project delivery environment. This study identifies the emerging challenges that the current design–build market is experiencing and defines a new key position in the design–build team to ensure that all engineering-related decisions are made by skilled and qualified engineers consistent with all of GDOT's policies and guidelines.

To achieve the goals, the research team first reviewed the academic/professional literature to determine the state of knowledge related to engineering decisions throughout the delivery of design–build projects beyond engineering plans and specifications. The research team then

created open-ended questions to identify any potential gaps in the engineering decision-making process throughout the design–build project development process and distributed the questionnaire with subject-matter experts (SMEs) in state DOTs. Interview protocols were developed. The research team interviewed the selected state DOTs to identify their innovative solutions for enhancing the state of engineering decision-making practices in handling multidisciplinary design and construction works in the design–build environment. In light of these developments, several areas are discussed:

- Opinions about the new role of a project chief engineer as recently required by GDOT in the request for qualifications (RFQ) of one of its design–build megaprojects.
- Primary key positions which are involved in the engineering decision-making process and any similar roles to PCE required in their DB and public–private partnership (P3) programs.
- Types of design–build projects (e.g., project size, complexity, level of design development, etc.) for which the new position has been utilized.
- Specific areas to which the new position should pay special attention while in charge of all engineering-related decisions throughout the construction phase of the project.
- Recommendations for the successful PCE implementation.
- Best practices for large DB and P3 projects.

To comprehend industry experts' understanding of the PCE implementation, the research team created the interview protocol and interviewed the SMEs from various professional groups, such as highway contractors, design consultants, owner's representatives, legal experts, and insurance experts. Eight broad themes emerged from the interview analysis:

1. The authority to stop work.
2. Overlaps between the PCE and other existing key positions.
3. A guarantor of performance.
4. Line of reporting.
5. Temporary vs. permanent structures.
6. Adding another decision-making authority.
7. A small pool of candidates.
8. Professional engineer licensing board.

Some design consultants raised a question about uninsurable liability risks regarding this position. A separate set of interviews with the insurance experts was conducted to identify any issues related to insurability. Combining the qualitative data received from the interviewees with content analysis, this research was able to conclude what is currently happening in the hardening insurance market for a professional liability policy, what has caused the insurance market solidification, and how the design–build transportation infrastructure industry can respond to recent changes.

From this series of interviews and content analysis, the research team concluded that the PCE will add value for large and complex projects requiring multidisciplinary parties that strengthen the design manager's role. However, the PCE requires a unique set of skills both in design and construction, which may limit the pool of candidates. Also, to avoid any perception of redundancy between the PCE and other key personnel in the DB team, a clear definition should be developed. The researchers believe that these findings are not limited in scope only to the PCE implementation. Instead, these are considerable areas of improvement to elevate the state of

engineering decision-making and advance design and construction integration in innovative program delivery.

CHAPTER 1. INTRODUCTION

RESEARCH BACKGROUND

The design–build (DB) delivery method is continuing to gaining momentum in the transportation industry. In 2018, the FMI Corporation prospected a bright outlook of a design–build delivery system that indicated about 13 percent increased design–build spending in the highway and transportation markets from 2018 to 2021 (FMI 2018). The DB delivery method is used at varying authorization capacities in transportation programs. As of March 2020, according to the Design–Build Institute of America (DBIA), DB had been fully authorized in 29 states and the District of Columbia, widely permitted in another 5 states, and authorized with certain limitations in 12 additional states; only four states do not authorize the use of design–build (DBIA 2020). Increasing the use of a DB delivery system relates to its benefits. The DB environment is designed to lessen administrative burden (Gad et al. 2015). Projects with a DB delivery system are delivered faster and with lower cost and shorter schedule growth than traditional design–bid–build (DBB) systems (Amekudzi-kennedy et al. 2016, Ashuri and Kashani 2012, Franz et al. 2020, Gad et al. 2015, Gransberg and Molenaar 2019). Further, public–private partnership (P3) project delivery systems, such as design–build–finance (DBF) and design–build–finance–operate–maintain (DBFOM), offer numerous benefits, as well (Mostaan and Ashuri 2015). These systems generate mutually beneficial, long-term contracts where private-sector entities provide operating and maintenance services for the public sector (Garvin et al. 2011). They make it possible to achieve broader objectives, reduce prices, and make schedules shorter and more consistent (Brown et al. 2009).

These increasing needs for alternative project delivery methods are derived from a flush with large and complex projects in the transportation infrastructure market. Project complexity increases due to rapid changes in the environment, increased product complexity, and increased time pressure (Williams 1999). In recent years, the construction industry has witnessed rapid growth in increasing size and complexity of projects (Luo et al. 2017). Infrastructure megaprojects are crucial to the future of cities and individual livelihoods (Garemo et al. 2015). A growing need to replace aging infrastructure becomes a leading driver of megaprojects in the transportation market (Knapschaefer 2019).

Megaprojects need to be managed effectively in order to achieve budget and schedule objectives. Understanding the increasing complexity of the megaprojects is key to the successful delivery of transportation infrastructure projects (Garemo et al. 2015, Williams 1999). An excessive number of change orders is an important risk in delivering large and complex infrastructure projects (Gad et al. 2020). Questions remain over whether the same organizational structures found in a typical DB project still benefit the large DB and P3 projects that involve multidisciplinary works. It highlights the needs for state departments of transportation (DOTs) to put somebody at the high-level decision-making in the DB team to protect the public interests in all decision-making matters related to all multidisciplinary engineering works exercised by the DB team. These concerns demand an in-depth investigation of how the design–build team needs to uphold the highest level of diligence in making all complex engineering decisions.

LITERATURE REVIEW

Rising Complexity of Transportation Megaprojects

Transportation projects continued to increase in size and complexity. Many designers, engineers, and contractors have participated in the project delivery, and various multifunctional activities impact the project construction schedule (Mudholkar 2008). Gharaibeh (2014) asserted that megaprojects are challenging, complex, and risky, inherent with many personnel and interfaces. A significant challenge for megaprojects is a lack of leadership and supervision in engineering and construction organizations (Gharaibeh 2014). Zhu et al. (2020) also stated that megaprojects face a high degree of technical complexity, and their risks far exceed that of general projects.

Increasing Needs for a New Leadership

Since large and complex projects involve multidisciplinary parties on board, the projects devote trustworthy leadership to handle issues arising from the multidiscipline nature. Hollenbeck and Trott (2008) studied the lessons learned for a successful megaproject in the suggestion of hiring an engineering firm with a hands-on project manager who is supported by a technically competent and well-organized project engineer. Fischer et al. (2011) analyzed four case studies and found that success correlates with engineering. The authors emphasized that the industry needs competent, smart, and well-educated engineers to ensure that field decisions are made using the required level of technical analysis (Fischer et al. 2011).

Since multiple parties are involved in the engineering decision-making process, especially for large projects, there is a need for a position that is responsible for the overall integration of work and can handle multiple engineering disciplines and resolve engineering issues during the construction phase. The researchers noticed that some state DOTs have extensively adopted a

new position as key personnel in their DB projects. The Virginia DOT (VDOT) Alternative Project Delivery Division recently started asking for a role, titled *entrusted engineer-in-charge* (EIC), as key personnel on complex DB and P3 projects over $100M (VDOT 2018). As a registered professional engineer, the EIC should make engineering decisions as needed for the project and ensure that complex engineering decisions involving multidisciplinary work are made by a professional engineer licensed in Virginia (VDOT 2019). Another critical responsibility is that the EIC should ensure that non-engineers do not make any engineering decisions (VDOT 2019).

Texas DOT (TxDOT), as part of its new quality organization, has defined a new role, *professional service quality assurance manager* (PSQAM). Requiring a professional engineer license, this position is in charge of all professional services, including design, environmental, utilities, right-of-way (ROW), and survey, for the DB corporate management team (Luschen **Error! Reference source not found.**). During construction, the PSQAM should certify that the design change has been checked per the contract documents and review any design changes in the design package. The PSQAM works closely with an independent quality firm (IQF) manager to oversee all professional services in DB projects. The PSQAM and IQF manager have a dual reporting responsibility to both the design–builder corporate management team and the TxDOT project manager.

Most recently, the Georgia DOT (GDOT) requested a new position, *project chief engineer* (PCE). According to a recently published request for qualification, this individual should verify that qualified discipline engineers sign and seal the work products and supervise all decisions throughout design and construction related to an engineering aspect. Also, the PCE is responsible for rejecting or approving the design work and resolving disputes regarding engineering work.

The new position is a different role than the *engineer of record*, who is ultimately responsible for the design and certifies and stamps each drawing for the discipline in charge. It is also a different role than the *design manager*, who considers both design and construction simultaneously and manages the flow of information between different design disciplines and construction trades to satisfy the owner's performance objectives and meet the design–build contractor's goals. GDOT intends that this new position will ensure an appropriate standard of care is exercised in the engineering decision-making process on the design–build team through developing an integrative plan by stages and disciplines.

There has been no detailed investigation of a new leadership position in the DB team for large DB and P3 projects. Elevating the state of engineering decision-making practices in the design–build environment needs to be better understood by exploring opportunities offered by the new position in the design–build team. An urgent need exists to identify what specific qualifications and skillsets are critical for the success of the new position as key personnel in the dynamic design–build project delivery environment.

RESEARCH OBJECTIVES

It is crucial to understand the underpinnings of engineering-related problems the design–build team faces during both the design and construction phases of the project and to identify how the engineering decision-making process should be effectively structured to minimize design risks in the innovative delivery environment. This research project primarily focuses on elevating engineering decision-making practices in the design–build environment by exploring opportunities offered by a new leadership position in the design–build team. This position is expected to become a go-to person in the design–build team who stands to certify that

appropriate engineering standard of care is administered in all the design–build contract work and who state DOTs can discuss all engineering-related issues with.

The overarching goal of this research project is to identify best practice guidance on defining Georgia DOT's expectations from the design–build team in proactive management of design-related issues in the innovative project delivery environment. In this study, the research team focuses on three main objectives. First, this study examines the main issues related to upholding the highest standard of care in the engineering decision-making process by the design–build team. Second, the emerging challenges that the current design–build market is experiencing are identified. Lastly, the study defines a new key position in the design–build team to be in charge of ensuring that all engineering-related decisions are made by skilled and qualified engineers consistent with GDOT's policies and guidelines.

CHAPTER 2. RESEARCH METHODOLOGY

OVERVIEW

Because of the nature of this topic, the researchers used qualitative research methods to achieve the objectives. The data in this research came from two primary sources—DOT contract documents and semistructured interviews—that were collected in written or verbal form and then summarized in narrative form. This research aimed to better understand a new leadership position as key personnel for DB megaprojects. The goal was to develop a detailed description rather than a measurement of particular variables. Thus, qualitative approaches were considered the most suitable methods to capture the views and perspectives of the people and embrace the contextual conditions (Yin 2016). Through the content analysis and the interviews with subject-matter experts (SMEs) in the DB transportation market, the researchers obtained enriched data to understand existing key personnel and a new leadership role in the context of the DB environment. Figure 1 describes an overview of the research methodology.

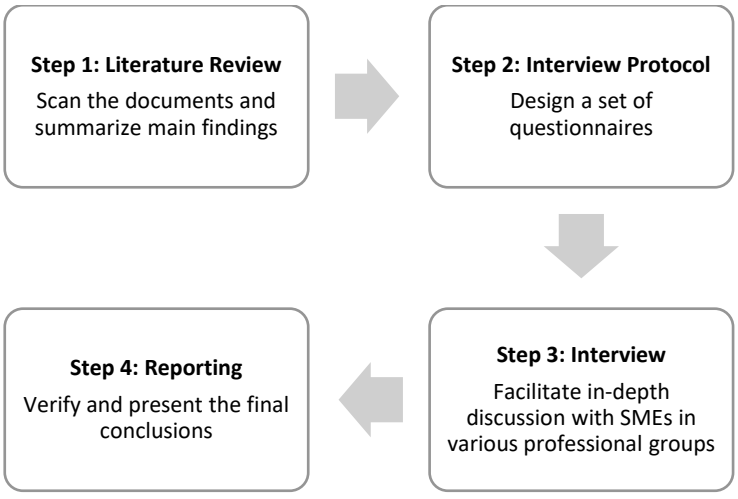

Figure 1. Diagram. Overview of research methodology steps.

The overarching objectives of this research were to identify a new key position in the design–build team in charge of engineering decision-making and describe its specific roles and responsibilities in the design–build process for delivery of transportation megaprojects. To achieve these objectives, the researchers expanded the steps of the research methodology to the following steps:

Step 1: Literature Review

1. Review the academic/professional literature to review the state of knowledge related to engineering decisions throughout the delivery of design–build projects beyond engineering plans and specifications.

Step 2 and 3: Interview Protocol and Interview

1. Create open-ended questions to identify any potential gaps in the engineering decision-making process throughout the design–build project development process, especially during the construction phase, and refine the questions by conducting dry-run interviews with selected SMEs to ensure that the questions are clearly crafted and the anticipated responses reflect the intent of the research.
2. Distribute the questionnaire with SMEs in state DOTs and follow up with them to receive as high a response rate as possible.
3. Create interview protocol and conduct interviews with the selected state DOTs to identify their innovative solutions for enhancing the state of engineering decision-making practices in handling multidisciplinary design and construction works in the design–build environment, especially during the construction phase.
4. Create the interview protocol targeted to the SMEs from various professional groups, such as highway contractors, design consultants, owner's representatives, legal experts,

and insurance experts, and conduct interviews with the SMEs to identify challenges in the current DB market and better understand the decision-making practices with respect to large DB projects.

Step 4: Reporting

1. Collect documents from state DOTs and industry experts following the interviews/emails (e.g., design–build manuals, design–build agreement, requests for qualifications [RFQs] and requests for proposals [RFPs] of past and current design–build projects, case laws, and market insights) and analyze the contents of these documents in several areas of interest, such as common practices in design professional liability insurance policy and requirements.
2. Identify the desired skillsets, professional background, principal roles, responsibilities, and duties of the new position in the integrated design–build team and describe how the new position fits with the organizational chart of the design–build team and its relationships with GDOT's project management team.
    a. Prepare a draft of the research report (draft final report).
    b. Refine the draft final report by a professional editor and submit the edited draft final report for GDOT review.
    c. After review by GDOT, prepare and submit the final research report (final report).

DISCUSSION OF RESEARCH METHODOLOGY STEPS

1. *Conduct an extensive review of the academic and professional literature related to quality management for alternative project delivery*: The main focus of the literature

review task was to examine emerging issues related to engineering decision-making in the design–build environment. The researchers investigated whether there are any potential gaps reported in design–build projects indicating that professional engineering-related decisions are made by people who are not technical experts in the engineering field. The research team reviewed any recommended models for upholding the high quality of engineering decision-making throughout multidisciplinary works in the design–build environment.

2. *Create open-ended questions for distributing via an initial emailed questionnaire and refine the questions by conducting dry-run interviews with selected SMEs:* The research team developed a set of initial questions as the first step to identify any potential gaps in the engineering decision-making process throughout the design–build project development process, especially during the construction phase. The researchers then sent the questions to several innovative delivery SMEs, such as the heads of the offices of innovative delivery programs in several state DOTs across the nation, to validate and refine the questions and make a final decision on the best questions to use in the initial questionnaire to get the best results. The research team then used the refined set of questions to gain and collect information to better understand the roles and responsibilities of key personnel in the large design–build projects and their primary duties.
3. *Distribute the questionnaire with subject-matter experts in state DOTs and follow up with them to receive as high a response rate as possible:* Researchers sent the questions to several innovative delivery subject-matter experts, such as the heads of the offices of

the innovative delivery program in several state DOTs across the nation, to validate the research team's findings from the literature review and the state of practices.

4. *Create interview protocol and conduct interviews with the selected state DOTs*: The research team developed more detailed questions for an in-depth interview and conducted semistructured interviews with eight state DOT personnel via a video call to identify the most appropriate organizational structure model and a new leadership position for filling any potential gaps in making engineering decisions during the construction phase of design–build projects. The areas of focus for in-depth interview were:
    a. Opinions and impressions on a new role of a project chief engineer as recently required by GDOT in an RFQ for a megaproject.
    b. Primary key positions which are involved in the engineering decision-making process and any roles similar to PCE required in their DB and P3 programs.
    c. Types of design–build projects (e.g., project size, complexity, level of design development, etc.) for which the new position has been utilized.
    d. Specific areas that the new position should pay special attention to and be in charge of all engineering-related decisions throughout the construction phase of the project.
    e. Recommendations for the successful PCE implementation.
    f. Best practices for large DB and P3 projects.
5. *Create the interview protocol targeted to the SMEs from various professional groups and interview the SMEs*: The research team developed more detailed questions for an in-depth interview targeted to the various professional groups such as highway

contractors, design consultants, owner's representatives, legal experts, and insurance experts. The research team first reached out to the following three professional associations:

a. American Council of Engineering Companies (ACEC) of Georgia, Georgia Partnership for Transportation Quality (GPTQ) Task Force.
b. Design–Build Institute of America, P3 Committee.
c. DBIA, Transportation & Aviation Committee.

To facilitate in-depth discussion with a wide range of professional groups, the research team used the snowball sampling method that is a technique for current research participants to recruit future ones in identifying other possible interviewees (Yin 2016). This method allowed the research team to discuss the current insurance market conditions and challenges associated with DB and P3 projects with those in the insurance and legal industries. The research team scheduled online video calls and followed a semistructured format. The areas of focus for in-depth interview were:

a. Opinions and impressions on a new role of a PCE as recently required by GDOT in an RFQ.
b. Potential challenges associated with this new position.
c. Key personnel in charge of critical responsibilities such as having the authority to stop work, working full-time during the construction phase, and reporting to the developer's project manager.
d. Any similar roles to PCE required in large and complex DB and P3 projects.
e. Types of design–build projects (e.g., project size, complexity, level of design development, etc.) in which the new position has been utilized.

f. Recommendations for successful PCE implementation.

g. Best practices for large DB and P3 projects.

6. *Collect documents from the interviewees following the interviews/emails and analyze the contents of these documents in several areas of interest:* Participants in the in-depth interviews mentioned several internal and external documents that contained valuable information regarding the design–build organizational structures. These documents explain how the state DOT handles engineering decision-making processes and key personnel in the organizational structure for design–build and P3 projects. These documents included, but were not limited to, design–build and P3 manuals, RFQs and RFPs of past and current design–build and P3 projects, and master contracts. The research team also collected documents from the interviewees in the insurance industry to explore the current insurance market conditions and challenges associated with design–build and P3 projects.

7. *Summarize and present in the research report the findings of all the information collected through emails, structured interviews, and content analysis:* In the final step of the research methodology, the research team had to assemble all the work from the earlier stages in an efficient manner to synthesize all the findings. The researchers worked from the extensive literature review for finding gaps in existing research, the interview protocols, and the interviews of various professionals in the different disciplines, and they performed content analysis on all the responses and documents shared by the interviewees. It was essential to compile this entire process and document the findings in a clear and lucid manner. Important industry practices, recommendations, best practices, and trends were identified while summarizing these

responses and all the available documents, which are highlighted in the following chapters.

CHAPTER 3. INTERVIEW WITH DOT PERSONNEL

OVERVIEW

In response to the need for a new leadership role in megaprojects, GDOT recently imposed a new role, titled "project chief engineer," in the RFQ of the SR 400 Express Lane project published in February 2020. The research team borrowed the language related to the PCE position found in the RFQ and developed an open-ended questionnaire along with the PCE description. This process was designed to investigate the state of the practices in key personnel requirements and identify state DOTs' experiences with handling engineering decision-making processes by their design–build teams throughout the project development process, especially during the construction phase. The questionnaire was sent to DOT personnel via email.

Next, semistructured interviews with the state DOT personnel enriched this research by examining the most appropriate organizational structure model. Understanding multidisciplinary engineering issues in megaprojects were addressed, and the needs of a new leadership position were discussed through in-depth interviews. In addition to the emerging issues in DB and P3 markets, the research team explicitly addressed the implementation of the PCE to further elaborate on this new leadership position. The questions posed to any given participant differed according to the context and setting of each interview. The interview protocol was developed to address the following key areas:

- Opinions and impressions on a new role of a PCE as recently required by GDOT in its RFQ.

- Primary key positions which are involved in the engineering decision-making process and any roles similar to the PCE required in their DB and P3 programs.
- Types of design–build projects (e.g., project size, complexity, level of design development, etc.) on which the new position has been utilized.
- Specific areas that the new position should pay special attention to and be in charge of all engineering-related decisions throughout the construction phase of the project.
- Recommendations for successful PCE implementation.
- Best practices for large DB and P3 projects.

UNDERSTANDING OF A NEW POSITION: PROJECT CHIEF ENGINEER

The research team developed the questionnaire to identify key personnel who handle engineering decision-making processes in their design–build teams throughout the project development process. They borrowed language from the description of a PCE's responsibilities in the GDOT RFQ, tweaked the descriptions, and embedded them in the questionnaire. The research team reached out to 15 state DOTs that regularly employ DB and P3 systems and received answers from the following 11 DOTs: Arizona, Florida, Maryland, Massachusetts, Minnesota, Ohio, Oregon, South Carolina, Texas, Virginia, and Washington. The state DOT personnel were asked to determine who in the design–build team is responsible for the following seven critical functions.

1. Being responsible for the supervision and quality of all design work and the design process throughout the design and construction period.
2. Being responsible for design accuracy, adequacy, and conformance to professional standards of practice.

3. Making all decisions throughout design and construction that are related to an engineering aspect of the project.
4. Rejecting or approving the design work throughout the design and construction period,
5. Resolving disputes regarding engineering work for the design integration into the final constructed product.
6. Verifying that construction processes do not undermine the safety and soundness of the design.
7. Having the authority to stop work on the project if any work does not meet the standards, specifications, or criteria for the project.

Table 1 shows the responses to the first question: *Being responsible for the supervision and quality of all design work and the design process throughout the design and construction period.* Most of the DOTs mentioned that a design manager is responsible for this particular task. Five state DOTs responded that a design quality manager accompanies the design manager on this task. Only Ohio DOT said that the quality manager is in charge of the supervision and quality of design work and the design process. TxDOT responded that the quality manager and the engineer-of-record (EOR) are responsible for this task. Additionally, TxDOT mentioned that its EOR could also serve as the design manager.

Table 1. Key personnel who are responsible for the supervision and quality of all design work and the design process throughout the design and construction period.

DOTs	Design Manager	Design Quality Manager	Engineer-of-Record
Arizona	✓		
Florida	✓	✓	✓
Maryland	✓		
Massachusetts	✓	✓	
Minnesota	✓	✓	✓
Ohio		✓	
Oregon	✓		
South Carolina	✓	✓	
Texas		✓	✓
Virginia	✓		
Washington	✓	✓	

As further discussion on this task, TxDOT explained that that the word "and" in this language representing "design work" and "design process" might not be intended to be one person. TxDOT elaborated that the EOR should perform quality control (QC) for design and determine a design process. A separate firm performs quality assurance (QA) of design. The design quality assurance manager (DQAM), which refers to an independent design quality manager employed by the independent quality firm, is responsible for the quality of the work being performed according to the design quality management plan (DQMP).

Like TxDOT, VDOT also employs an independent quality firm, but it is primarily engaged in the construction phase. A design manager is responsible for design quality assurance, and a quality assurance manager employed by the independent quality firm is responsible for construction QA. VDOT has a different leadership role, called a *responsible charge engineer*, and this position is responsible for the overall integration of work. The Washington State DOT (WSDOT) commented that where more than one design–build team member is listed, the order is based on

the proper organizational hierarchy. For instance, the design quality manager shall report to the project quality manager. The project quality manager shall report directly to the person or group with overall project management responsibilities, such as the project manager. Note that the design–build project manager, construction manager, and EOR have equal authority to stop work on the project if any work does not meet the standards, specifications, or criteria for the project. The Florida DOT (FDOT) mentioned that the design project manager, assisted by the FDOT owner's representative, ensures the appropriate reviews of design submittals have occurred within FDOT and facilitates resolution of review comments and releases of the design plans for construction.

Table 2 describes the responses to the second question: *Being responsible for design accuracy, adequacy, and conformance to professional standards of practice*. The results show the critical role of the EOR in performing this task. The Oregon DOT mentioned that the EOR is responsible for this task per Oregon professional engineer law. FDOT commented that the EOR signs and seals the design, and the design quality manager provides the QC and QA.

Table 2. Key personnel who are responsible for design accuracy, adequacy, and conformance to professional standards of practice.

DOTs	Design Manager	Design Quality Manager	Engineer-of-Record
Arizona	✓		
Florida		✓	✓
Maryland	✓		
Massachusetts			✓
Minnesota	✓	✓	✓
Ohio			✓
Oregon	✓		
South Carolina			✓
Texas			✓
Virginia	✓		✓
Washington	✓		✓

For the third question, the state DOT personnel were asked to provide all the positions that are *making all decisions throughout design and construction that are related to an engineering aspect of the project*. As many disciplines work on a roadway set of plans, responses were widely distributed to multiple positions. Table 3 shows that at least six positions are involved in the engineering decision-making process. Instead of naming positions, TxDOT answered that multidisciplinary parties are involved. TxDOT further described that if one engineer changes side slopes, it could affect channel capacity. It is not uncommon that multiple EORs sign plan sheets and then the files are merged on one plan sheet for the design manager to sign, but each discipline signs the specific details. Thus, all decisions are made depending on the item. The construction manager may request a change, and the project manager and the crew may run traffic control. The Oregon DOT also explained that the EOR, the Oregon DOT resident engineer, and the contractor might share aspects of "all decisions throughout design and construction."

Table 3. Key personnel making all decisions throughout design and construction that are related to an engineering aspect of the project.

DOTs	Design Manager	Design Quality Manager	Engineer-of-Record	Responsible Charge Engineer	Project Manager	Owner	Various Parties
Arizona	✓				✓	✓	
Florida					✓		
Maryland	✓		✓				
Massachusetts			✓		✓	✓	
Minnesota	✓	✓	✓				
Ohio	✓	✓					
Oregon	✓						
South Carolina		✓	✓				
Texas							✓
Virginia				✓			
Washington	✓		✓				

The standard position in charge of the engineering decision-making process is the EOR. TxDOT mentioned that by Texas State law, a reasonable notice has to be given to the EOR that there are changes to their signed and sealed plans; however, whoever changes them assumes liability. The Minnesota DOT (MnDOT) commented that the design manager is responsible for giving their EOR signature. However, the project manager is often heavily involved, and the balance between the two feels a little different on each project. Maryland DOT explained that the design manager and/or EOR is ultimately responsible. If the EOR is different from the design manager, the EOR must sign and seal the plans and ensure the engineering met the appropriate standard of care and requirements. The project manager can give input into the design but within a limited liability, as they are not signing/sealing the plans. Florida DOT emphasized that all decisions must be consistent with the contract documents. Engineering decisions should be made by the EOR working closely with their construction partner for constructability decisions. Still, all decisions must comply with the contract documents, and the RFP must clearly describe the scope of work.

Like the third question, the fourth question (Table 4) about *rejecting or approving the design work throughout the design and construction period* shows that diverse positions are involved in this task. FDOT explained that the FDOT design project manager is charged with release to construction for design plans. Until the FDOT design project manager has been satisfied with the resolution to review comments, the plans will not be released for construction. All contracts include an escalation procedure should a decision not be resolved at the project level. Within the DB firm, issues will be handled with the design–build project manager. From the FDOT side, the design project manager and a resident engineer are engaged in the process based on RFP requirements.

Table 4. Key personnel rejecting or approving the design work throughout the design and construction period.

DOTs	Design Manager	Design Quality Manager	Quality Manager	Engineer-of-Record	Responsible Charge Engineer	Project Manager	Owner
Arizona						✓	✓
Florida						✓	
Maryland			✓				✓
Massachusetts				✓		✓	✓
Minnesota	✓						
Ohio	✓	✓					✓
Oregon		✓	✓				
South Carolina		✓		✓			
Texas		✓					
Virginia	✓				✓		
Washington	✓			✓			

Following the current system of the Arizona DOT, after the Arizona DOT has completed the design review, the resident engineer, project manager, and general engineering consultant (GEC) must sign off on a form before plans are released for construction. The GEC assists during the development of the RFP, DB selection process, and post-award design review. MnDOT

mentioned that the design manager, project manager, and MnDOT are involved in the process, whether rejecting or approving the design work. The design manager performs this task, followed by the MnDOT oversight staff. The project manager is also involved in this chain, but the project manager does not sign the plans. The Ohio DOT mentioned that the design manager and design quality manager are responsible for this task, followed by final quality auditing by the Ohio DOT.

Table 5 describes the fifth question about *resolving disputes regarding engineering work for the design integration into the final constructed product*. The results also show that various parties are involved in the dispute resolution process. The research team received insightful comments from the DOT personnel that the dispute resolution process can be handled differently depending on whether disputes arise within the DB team or above the project level. Regarding the disputes within the DB team, TxDOT suggested that the independent quality firm—i.e., the independent quality assurance manager—needs to engage in the dispute resolution process. MnDOT affirmed that it depends on what is involved in the dispute. In general, the project manager, design manager, and construction manager are expected to argue this unless the contractual language is in dispute. In this case, the DOT then becomes involved. The Maryland DOT also mentioned that if the dispute is internal to the design–build team, they must work it out. VDOT contracts allow an escalation from the project manager to a senior representative to resolve the issues. If they cannot resolve it, the Commissioner will settle at the end, or the contractor will follow legal action.

Table 5. Key personnel resolving disputes regarding engineering work for the design integration into the final constructed product.

DOTs	Design Manager	Design Quality Manager	Quality Manager	Engineer-of-Record	Responsible Charge Engineer	Project Manager	Owner
Arizona						✓	✓
Florida						✓	
Maryland			✓				✓
Massachusetts				✓		✓	✓
Minnesota	✓						
Ohio	✓	✓					✓
Oregon		✓	✓				
South Carolina		✓		✓			
Texas		✓					
Virginia	✓				✓		
Washington	✓			✓			

Pertaining to those disputes that cannot be resolved at the project level, FDOT explained that they are escalated in accordance with the contract document. In this case, from the DB firm, the construction manager or design–build project manager is in charge of the resolution process. From the FDOT side, the design project manager and the resident engineer are required based on RFP requirements. Maryland DOT elaborated on the dispute resolution process. If it is determined by the owner, the Maryland DOT will request the design–builder to address it. The Maryland DOT would resolve any dispute with the department and design–builder through partnering and issue resolution ladder formal contractual means if required. The Arizona DOT resident engineer has the final say on how the specifications are interpreted or applied. This is also done with support from others, but if he or she says no, the next step would be to escalate the decision to the state engineer's office.

As the sixth question represents the construction phase, described as *verifying that construction processes do not undermine the safe and sound design intent*, many DOT personnel included the

construction manager and construction quality manager (see table 6). The quality manager in the answers from TxDOT and Maryland DOT refers to the independent quality manager. Florida DOT further described that construction processes must follow the release for construction plans and specifications. There are measures in place to ensure that what is constructed is compliant with the design plans and specifications. Every project has a construction engineering inspection (CEI) team working for the owner, who is assigned to ensure the final product is compliant with the plans and specifications. Oregon DOT illustrated that the contractor would provide a schedule for the work and a shorter look ahead traffic control schedule to coordinate with other projects or events. Arizona DOT's comment also related to the schedule; they emphasize schedule-sensitive activities, so all involved parties understand the proposed sequence of work.

Finally, for the last question about *having the authority to stop work on the project if any work does not meet the standards, specifications, or criteria for the project*, the results highlighted the roles of the project manager and construction manager. Table 7 shows that various positions have stop-work authority. In addition to the eight positions, including the owner, additional parties are involved in this task. Oregon DOT mentioned that the environmental manager and their resident engineer typically have a right to stop the work. MnDOT also mentioned the environmental manager, and Arizona DOT expressed the same responses about their resident engineer. For safety-related issues, the CEI firm working for FDOT can stop the work.

Table 6. Key personnel verifying that construction processes do not undermine the intent of the safe and sound design.

DOTs	Design Manager	Quality Manager	Engineer-of-Record	Responsible Charge Engineer	Project Manager	Construction Manager	Construction Quality Manager	Owner
Arizona					✓			
Florida						✓		
Maryland		✓						✓
Massachusetts			✓		✓	✓		✓
Minnesota					✓			
Ohio							✓	
Oregon	✓				✓	✓		
South Carolina			✓					
Texas			✓					
Virginia				✓				
Washington	✓		✓		✓	✓		

Table 7. Key personnel having the authority to stop work on the project if any work does not meet the standards, specifications, or criteria for the project.

DOTs	Design Manager	Quality Manager	Engineer-of-Record	Responsible Charge Engineer	Project Manager	Construction Manager	Construction Quality Manager	Owner
Arizona								✓
Florida						✓		
Maryland		✓						✓
Massachusetts					✓		✓	✓
Minnesota					✓	✓	✓	
Ohio	✓		✓					
Oregon	✓							
South Carolina		✓						✓
Texas			✓					
Virginia		✓		✓				
Washington			✓		✓	✓		

IN-DEPTH DISCUSSION ON PROJECT CHIEF ENGINEER

After analyzing the questionnaire, the research team planned to perform semistructured interviews to enhance understanding of emerging issues in DB and P3 markets and the PCE implementation. The research team excerpted the language of the PCE from the GDOT RFQ and explicitly included this description in the interview invitation to the DOT personnel. Of 11 individuals representing 9 state DOTs, interviews via video calls were scheduled with 7 individuals from the following 7 DOTs: Arizona, Colorado, Florida, Maryland, Minnesota, Oregon, and Washington. The interviewees were asked to address a series of predetermined but open-ended questions. Though the questions differed based on the context and setting of each interview, the interview protocol followed this guide:

- What do you think about the new role of Project Chief Engineer (PCE) as required by GDOT in the RFQ phase of the GA 400 Express Lane project?
- When would the PCE position be meaningful?
- Do you have any roles similar to PCE required in your DB and P3 projects?
- Which areas does the PCE need to pay special attention to?
- What would you recommend for successful PCE implementation?
- What are the best practices for large design–build project and P3 projects?

Overall Opinions on Project Chief Engineer

The first interview question was to obtain overall perspectives toward the PCE, a new leadership position introduced by GDOT. Regarding the question *what do you think about the new role of Project Chief Engineer (PCE) as required by GDOT in the RFQ phase of the GA 400 Express Lane project?*, most DOTs like the idea of requiring the new position in large and complex DB

and P3 projects. One respondent mentioned that it would be beneficial for the PCE to know intricacies such as financing and issue escalation. However, this interviewee explained that it seems as though the PCE is required to have a unique set of skills both in design and construction. They wonder how GDOT can fulfill candidates with such a specialized skill set. Most respondents mentioned that it would be better for the PCE to be on the construction side rather than on the design side, but this position would require a licensed professional engineer (PE). Continuity from the proposal phase to the project execution phase was another desired feature for including the PCE. One interviewee highlighted that good wording is needed to acquire a higher level person to handle the appropriate authority and responsibility.

Some DOTs expressed concern about potential challenges in implementing the new role because the PCE has a great deal of power on the engineering side, especially the authority to stop work. Some interviewees voiced concerns about this authority becoming an issue for highway contractors to accept the new position. Also, the PCE may have overlapping duties with the design manager and/or quality manager. One interviewee explained that since contractors are not doing the design, it is alarming to insert someone who can change the design, which would create back charges if the design were wrong. A few recommendations were made to improve the language of the PCE description. For example, more detail is needed to define the exact expectations from the PCE during the construction phase of the project. For instance, how often does the PCE need to visit the jobsite? What verification tests need to be conducted by the PCE? What is the interface between the PCE and the construction quality acceptance firm (CQAF)?

Types of Projects that Gain Value from a Project Chief Engineer

The research team then followed up with the question about *when would the PCE position be meaningful?* The majority of participants agreed with the statement that the PCE adds value for large and complex projects and is beneficial when projects need to strengthen the design manager's role. Commenting on the factors influential in the decision to include the PCE as key personnel, the interviewees mentioned several areas to consider: project dollar values, complexity thresholds, project size, projects with several phases, projects with interfaces with other projects in the neighboring area, management of several interfaces among multiple design disciplines, and needs for systems integration and testing.

Existing Roles Similar to Project Chief Engineer

There were various responses regarding the question *do you have any roles similar to PCE required in your DB and P3 projects?* MnDOT said that the design manager is responsible for everything. The design manager wears multiple hats, including conflict resolution. However, the design manager in the current MnDOT setting for design–build teams may not be high enough up in the organizational structure to advocate for good design. FDOT commented that the design–build coordinator is similar to the PCE without the heightened authority level. With Florida DOT projects, the design manager oversees 95 percent of submission, including all plans and specifications, and the design–build coordinator coordinates comprehensive contractual documents. Colorado DOT mentioned that the PCE sounds like the design manager and owner's verifications. WSDOT indicated that the PCE is similar to the design manager but slightly different—the design manager has no authority to stop the work. Oregon DOT said that the project manager and design manager are similar to the PCE. The project manager has the

authority to make decisions onsite. The design manager and the EOR need to visit the jobsite to address issues raised by the DOT.

Relating to this question, some DOTs, including Arizona, consider the PCE to be similar to the quality manager. Also, the independent quality manager has the authority to stop work for design and construction services, but rejecting the work may not appear as a core responsibility of the quality manager. Similar to Arizona DOT, Maryland DOT felt the independent quality firm is similar to the PCE. The independent quality firm is responsible for both design and construction compliance. In addition, the EOR and other design stakeholders are expected to go to the field for design changes but are not required to visit the site on a regular basis.

Areas That Need Project Chief Engineer Attention

For the question on *which areas does the PCE need to pay special attention to?,* some DOTs mentioned two primary areas: field design changes and temporary structure. Field design changes have to go through the respective EOR for disciplines affected by the changes. Without the EOR's approval, changes should not be implemented. Also, temporary structure design and implementation are the contractor's primary responsibility and not the design team's. Thus, the PCE needs to ensure that the construction quality manager oversees the process.

Recommendation for Project Chief Engineer Implementation

On the question *what would you recommend for successful PCE implementation?,* several comments were received. Some DOTs mentioned that the duties of the PCE during construction need to be clearly spelled out in the RFQ and RFP. Also, this position cannot serve other duties. In fact, double-duty should not be allowed. In the RFP, one participant thought that technical scores need to have greater weights in proposal evaluation than price scores. The organizational

structure needs to be enhanced to indicate a clear line of reporting, such as decision-making authority. Also, all other communication channels need to be well defined in the proposed organizational chart of the design–build team.

Best Practices for Large DB and P3 Projects

A variety of perspectives were expressed regarding *what are the best practices for large design–build and P3 projects?* Four broad themes emerged from the responses: key personnel, minimum qualification, issue escalation, and familiarity with the departments. The majority of interviewees agreed with the importance of key personnel. One interviewee commented that it is preferred to keep the list of key personnel short as there are many changes anticipated throughout project pursuit to project execution. Another interviewee also said that providing flexibility to the design–build team to staff its team as appropriately as possible is recommended, keeping prescriptive positions to the minimum level necessary. The design–builder can add more key positions depending on the project needs and its own preference to perform the job. The design–builder has the latitude of a showcase of experts. Other responses to this question included keeping the list of key personnel consistent throughout the entire program to provide clarity for the industry.

Some respondents commented that staying with minimum qualifications can help the DOT to keep the pool of qualified professionals open as much as possible. Also, the RFQ and RFP requirements for key personnel do not need to be too prescriptive. Some reported that there is a need to develop a resolution ladder for the project. The design manager, quality manager, construction manager, and department should sit down together to resolve the issues by following the process in the issue escalation. For instance, FDOT uses dispute review boards

(DRBs) as an alternative dispute resolution mechanism. One interviewee highlighted that working experience with the local market is essential when selecting a design–builder and its key personnel.

SUMMARY

This chapter provided in-depth analysis to study the understanding of needs for a new leadership position and reviews of the project chief engineer role introduced from GDOT. Special attention was given to determine the challenging areas to uphold the integrity of engineering practice. The research team explored the roles and responsibilities of key personnel, and which entity in the design–build team is in charge of making engineering decisions during the construction phase of the project.

As the first step, an email interview identified that similar responsibilities are sometimes assigned to more than one design–build team member, depending on the item. The lead designer typically serves as the lead engineer-of-record. In some states, such as Minnesota and Virginia, the EOR could also be the design manager. Regarding the decision-making process, multidisciplinary parties are involved in the decision-making process, and all decisions must be consistent with the contract documents. Disputes that cannot be resolved at the project level are escalated in accordance with the contract document, followed by escalating the decision to the owner.

Followed by the questionnaires via email, the research team conducted semistructured interviews with state DOT personnel. Overall, most DOTs favored the idea of requiring the new position in large and complex DB and P3 projects. Significantly, the PCE was viewed to add value for large and complex projects that need to strengthen the design manager's role. However, the PCE

requires a unique set of skills both in design and construction; the pool of qualified personnel would be limited. Thus, the RFQ and RFP should clearly describe the responsibilities of the PCE and pay special attention to the duties during the construction phase.

CHAPTER 4. INTERVIEW WITH INDUSTRY EXPERTS

OVERVIEW

Following the interviews with state DOT personnel, the research team designed in-depth interviews to gather more detailed and thorough perspectives from SMEs. In this step, the research team emphasized the PCE implementation. To obtain expertise in the particular transportation DB and P3 market, the research team reached out to the following three professional associations:

- ACEC of Georgia, Georgia Partnership for Transportation Quality Task Force.
- DBIA, P3 Committee.
- DBIA, Transportation & Aviation Committee.

To facilitate in-depth discussion with a wide range of professional groups, the research team used the snowball sampling method, which is a technique for current research participants to recruit future ones by identifying other possible interviewees. The research team conducted the first set of interviews with members of the above-listed professional associations, and they referred SMEs in their network. This process allowed the researchers to obtain valuable opinions from various professional groups, especially the insurance market.

The selected interviewees were each sent an email describing the PCE roles and responsibilities, and the research team followed up after the email to schedule a video call interview. As the researchers had embedded the PCE language that appeared in the active GDOT RFQ into the interview invitation, some members of the professional associations expressed concerns about any conflict of interest and did not participate in the interview. Figure 2 describes a profile of the

29 interview participants and their professional groups, including highway contractors, design consultants, owner's representatives, legal experts, and insurance experts. Two of the design consultants are specialized in risk management. One of the insurance experts is working as an insurance underwriter, and the remaining respondents represent insurance brokers. The research team interviewed the legal experts via email.

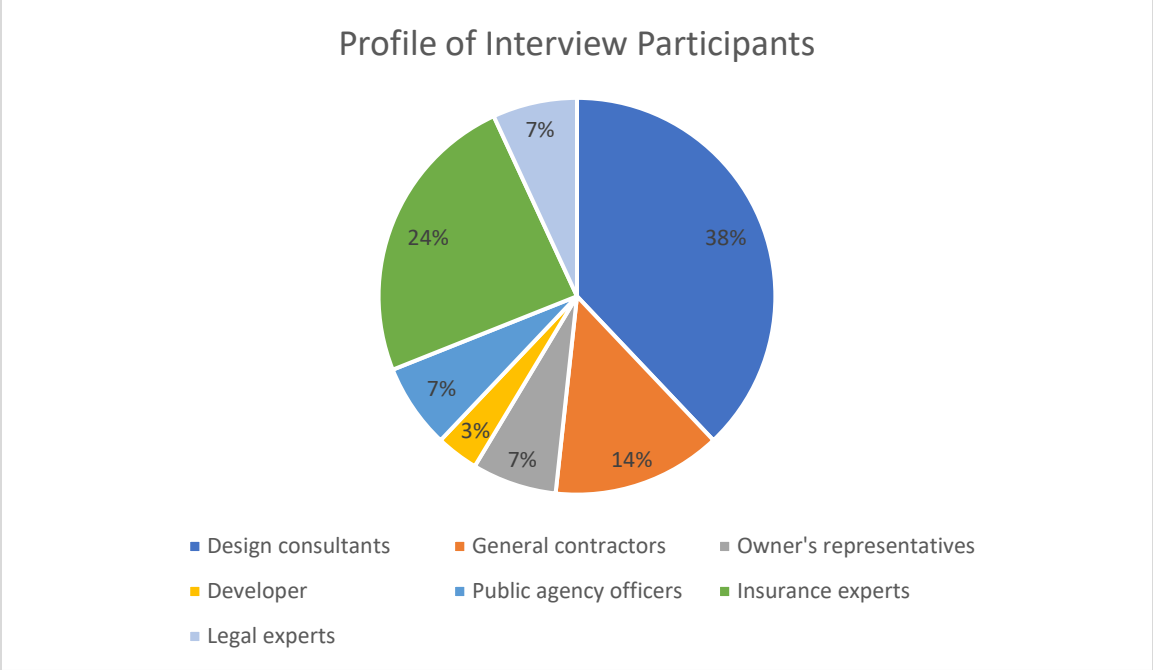

Figure 2. Pie graph. Interview participants by profession.

Throughout the three separate sets of interviews, the research team obtained valuable opinions from SMEs regarding PCE implementation. From the first set of interviews with design consultants, general contractors, owner's representatives, developers, and public agencies, eight broad themes emerged from the analysis. The second series of interviews with insurance and legal experts involved topics regarding the insurability of this position. Finally, the research team had an in-depth discussion related to the current professional market conditions, on which chapter 5 further elaborates.

POTENTIAL ISSUES RELATED TO PROJECT CHIEF ENGINEER

The overarching goal of this step was to identify the engineering decision-making process and PCE implementation in the large and complex DB and PC environment. Throughout the interview, the research team obtained valuable insights about this new position and how it may apply to delivering complex DB and P3 projects. To familiarize the interviewee to the PCE role, the research team included the following critical responsibilities of this position, excerpted from the GDOT RFQ:

- Responsible for the supervision and quality of all design work and design processes throughout the full design and construction period, including accuracy, adequacy, and conformance to professional standards of practice.
- All decisions throughout the design and construction that are related to an engineering aspect of the project must be made under the supervision of the Project Chief Engineer.
- The Project Chief Engineer shall certify the above prior to submission of design work for GDOT review and/or use.
- The Project Chief Engineer is responsible for rejecting or approving the design work, resolving disputes regarding engineering work, for the design integration into the final constructed product and verifying that construction processes do not undermine the intent of the safe and sound design.
- The Project Chief Engineer must have the authority to stop work on the Project if and when he/she knows or has reason to believe that any work does not meet the standards, specifications, or criteria established for the Project.

- The Project Chief Engineer shall verify that qualified and appropriately licensed and registered specialty/discipline engineers sign and seal work products for a given item, element, or phase of the work as applicable, including the released for construction plans, as well as revisions on construction and shop drawings.

The in-depth interviews allowed the researchers to explore several topics and investigate new questions raised from the discussion. They summarized the data collected from the interviews and conducted a qualitative analysis of expert perspectives. This analysis can enhance the understanding of the critical role of the engineer in the DB environment and help determine more appropriate strategies for the PCE implementation at GDOT. The research team planned to start with each expert's background or experience in the DB and P3 environment and progressively gather their understanding of some critical topics related to the PCE. From the first set of interviews, eight broad themes emerged from the analysis:

1. Authority to stop work.
2. Overlaps between the PCE and other existing key positions.
3. A guarantor of performance.
4. Line of reporting.
5. Temporary vs. permanent structures.
6. Adding another decision-making authority.
7. A small pool of candidates.
8. Professional engineer licensing board.

Authority to Stop Work

A majority of interviewees who responded to the stop-work authority felt that they do not have a problem accepting this authority. A general contractor and several design consultants said it should be okay if it is generally in the realm of safety concerns. In essence, everybody on the work has the authority to stop work for safety concerns, and it is an actual authority they encourage people to utilize. Some interviewees argued that the stop-work authority is an authority a consulting engineer should not accept. For instance, two interviewees familiar with the Georgia market referred to the following GA licensure requirements: "If any stop work authority is granted to PCE, it should be in line with GA licensure requirements (Rule 180-6-.02 Protection of the Public), which places a duty on the Engineer to 'inform' the proper authorities." They further described that having this authority does not grant the engineer a right, obligation, and ability to actually stop work. The research team also noticed that some design consultants are not really in favor of accepting this authority. They would prefer that the contract stay silent about the authority to stop work because engineers are not in the field all the time to check means and methods. Thus, if something was done improperly and the engineer did not say anything, there would be a liability issue.

The research team discussed this particular issue with a legal expert who practices law in Georgia. The legal expert explained the authority delegation from a different perspective. It is a matter of right versus duty. Authority means the engineer has the right to stop the work if she or he knows or reasonably believes that the work does not meet the standards, specifications, or criteria established for the project. This is different from a duty to verify, confirm, or warrant that the work meets the standards, specifications, or criteria established for the project. A duty would

warrant the work of others. A right just allows the engineer to take steps to protect the work and workers if he or she sees something that is wrong.

Overlaps Between PCE and Other Current Key Personnel

Several interview participants mentioned that they have several positions in charge of similar duties as the PCE. A general contractor mentioned that this role is similar to the EOR and had overlapped duties with the design coordinator. Another general contractor mentioned that the PCE role sounds more like an independent quality manager who has the ability to report outside of the chain of command to executive staff. In addition, a design consultant also said that the PCE has a significant role in coordinating QA tasks. It seems like the PCE role has some similar responsibilities as the QA manager.

Talking about these overlapped duties, the interviewees said a clear distinction should be made between PCE and EOR. A design–build director from a general contractor firm emphasized the distinction between the EOR and the PCE. Ultimately, the EOR is responsible for error and omissions, and its surety is the only one that will respond to a claim. If the PCE is not sealing the design, the contractor and owner should not value any policy coverage of the PCE, only coverage of the EOR. Suppose the PCE is sealing the design as a certifier. In that case, any claim will be complicated to settle unless the same firm employs the PCE as the EOR, which shows the duplication of the duties. A public agency officer recommended the PCE should only sign the cover sheet, and the EOR for each discipline should sign the respective plan sheet(s).

Several respondents have been thinking of the PCE role as an elevated design manager role, as one said, “design manager on steroid.” Thus, they suggested a clear distinction should be made between the PCE and the design manager. Some DB specialists understand the inherent

differences between the two roles related to design quality assurance and involvement during the construction phase. Overall, explicit clarification can help reduce any possible ambiguity.

A Guarantor of Performance

Commenting on the PCE requirements, the research team noticed an unfounded belief that the PCE takes the risk away from the contractor—DB entity—with the overall risk of doing things right. This leads to fear in the design community that accepting the PCE position creates the potential for the design professional to be a guarantor of performance, which is not covered by a typical professional liability (PL) insurance, also known as an errors and omissions (E&O) policy. Based on the interview with a legal expert, this belief is not correct. He exemplified the case in Virginia with English Construction and its lead inspector and quality manager, where English raised just that type of argument. English made a change on the job site but did not make their lead engineer know the change. When this change resulted in damages, English filed a claim against their QC and QA firms. The court rejected English's claim because all parties, including QC and QA firms, followed the chain of command, and English is ultimately responsible for the quality of the construction.

Line of Reporting

On the reporting line, a general contractor mentioned that the described PCE position has unusual reporting lines. The PCE should report to the design–build project manager rather than the special-purpose vehicle (SPV)—P3 developer. A design consultant mentioned that the PCE interfaces with quality management, so the independent quality manager should report any QA/QC issues to the PCE. Some interviewees commented that GDOT might ultimately want to decide whether it wants to impose a preferred reporting structure and communication channels to

the DB team. On the other hand, several respondents advised against such rigid prescriptions. They suggested that GDOT allow the DB team to decide what organizational structure best fits the needs of the project, which brings more flexibility.

Temporary vs. Permanent Structures

Some interviewees further discussed temporary and permanent structures. A design consultant mentioned that the distinction between temporary and permanent work is a matter of insurance. Insurance coverage between temporary and permanent work is very different, and it is easier to ensure the temporary than the permanent structures. The design community can benefit from clarifying the distinction between the two types of structures and how it applies to the PCE role.

Adding Another Decision-Making Authority

Only a small number of respondents indicated that creating a new leadership position might add another design-making authority. One developer mentioned that the PCE adds another layer to resolve a dispute in a timely manner. He further expressed a potential issue that this additional position may delay the decision-making process and the overall schedule, stating, “All the stakeholders raise their hands and say it doesn’t work. With PCE, you’re inserting yet another person who can raise her/his hand.” However, this characteristic may be placed in the PCE description by choice, in order to elevate the status of PCE in resolving engineering decision matters. The design–builder or the developer should develop a decision-making authority matrix to describe the order of decision-making clearly.

A Small Pool of Candidates and Minimum Qualifications

The majority of participants agreed that the pool of candidates for the PCE position is incredibly small. However, a design consultant mentioned that minimum qualifications should be more

stringent for a senior-level person. Another design consultant recommended that 15 years of relevant experience be suitable for this position, and 10 years would not be enough. Also, most interviewees recommended adding familiarity with GDOT practices. A public agency representative commented that minimum years of qualifications explicitly indicate any relevant experiences related to design–build and P3 projects in the past.

Some interviewees expressed concerns about the challenges for a design firm to lock its best people for 5 to 7 years of the project duration. However, once a design is finished, most engineering-related tasks during the construction will be primarily procedural and administrative, and not highly innovative tasks. Also, many design firms use a workforce development strategy during the transition from design to construction in DB projects.

Professional Engineer Licensing Board

One qualification of the PCE is to hold a PE license issued in the relevant state. In some states, the professional engineer licensing board may have an issue with regard to the new PCE role. A public owner shared his experience to resolve this issue by requiring the PCE to be a direct employee of the developer or the design–builder. The PCE has to work directly for the contractor or the DB joint venture (JV). A consultation with the Georgia PE licensing board may be an appropriate strategy to mitigate the risk.

INSURANCE ASPECTS OF PROJECT CHIEF ENGINEER

Some design consultants raised a question about uninsurable liability risks regarding the PCE. Following up on the potential issues discussed with the SMEs, the research team planned to determine gaps in implementing a new leadership role in the GDOT. The researchers were

interested in how the subject-matter experts think this position can be beneficial and apply to delivering complex DB and P3 projects from the design professional liability insurance standpoint. The research team interviewed legal experts to receive their comments and further discuss with insurance experts familiar with transportation DB and P3 markets.

Echoing with the first series of interviews, the researchers obtained similar perspectives regarding insurability from the insurance experts. The qualitative analysis summarized that the insurance industry considers five inherent issues concerning the roles of the PCE: (1) the heightened standard of care, (2) broad terms, (3) ensuring contractor's obligation, (4) ensuring works by third parties not in contractual privity with the PCE, and (5) obligation to stop work. Most insurance experts expressed similar suggestions over the six elements of the PCE description. Some emphasized the particular elements because of their expertise and interests, but, in general, the position does not create obligations, risks, or liabilities inconsistent with the PL coverage. The research team believes that these findings do not limit the scope that only applies to the PCE implementation. Instead, these are considerable areas of the engineers that need to be highlighted in the integrated project delivery environment.

1. **Responsible for the supervision and quality of all design work and design process throughout the full design and construction period, including accuracy, adequacy, and conformance to professional standards of practice.**

   From the first set of the interview, one of the design consultants mentioned that this language might transcend the industry-accepted standard of care for design professionals regarding "accuracy" and "adequacy." From the legal expert's perspective, this language could be a promised result, but it depends on the contract that GDOT and the PCE sign. The insurance experts provided similar comments. Several

respondents mentioned that the words “accuracy” and “adequacy” imply a guarantee of an engineer’s work, which is typically considered above the standard of care.

Those insurance experts further explained that engineers do not usually accept responsibility for the design of temporary structures that lie with the contractor. Accepting this responsibility can expose the design firm’s corporate program beyond the traditional practice. Also, the term “all” in “all design work” needs to be clarified because the PCE could only be responsible for the design work for which it has performed itself or through its own subconsultants. A legal expert said that “an engineer may be liable for negligently coordinating the design of others, but a plaintiff would need to show that the engineer didn’t meet the standard of care for coordinating the work of others.” In case of any claims, the PCE’s PL policy can be dragged into the claim in addition to the design subconsultant’s own PL policy. This extends the liability exposure of the PCE firm beyond what is normally assumed. A legal expert working as the general counsel for an engineering consulting firm commented that it might include a disclaimer stating, in effect, that the PCE is not responsible for the negligent acts or omissions of other licensed design professionals.

2. **All decisions throughout design and construction that are related to an engineering aspect of the project must be made under the supervision of the Project Chief Engineer.**

Several respondents had comments about the term “supervision” used in this statement. Several design and construction subconsultants are working on a design–build project at any point of time. The PCE firm does not have contractual privity with most of these design and construction subconsultants. Accepting the supervision responsibility

extends the professional liability of the PCE firm beyond those firms that the PCE firm actually hires.

In the DB environment, the design–builder selects several firms to work on the project. The PCE firm may not have been involved in the selection of those subconsultants and subcontractors. Accepting the responsibility of supervision of all those firms is something different than what is normally accepted by design firms. It implies that the PCE firm was involved in the selection. Similar to the comments on the first PCE description, when any claims arise, the PCE might use their PL policy to cover the claim in addition to the subcontractor's PL policy. This also extends the liability exposure of the PCE firm beyond what is typically assumed.

3. **The Project Chief Engineer shall certify the above prior to submission of design work for GDOT review and/or use.**

   Overall, most insurance carriers typically do not like to see that their insureds accept the certification responsibility. Stamping the work the PCE does not supervise can violate the state professional licensing provisions.

4. **The Project Chief Engineer is responsible for rejecting or approving the design work, resolving disputes regarding engineering work, for the design integration into the final constructed product, and verifying that construction processes do not undermine the intent of the safe and sound design.**

   A design consultant mentioned that the safety of the final design is not tested or validated by construction processes. The design–builder is exclusively responsible for the construction processes and its selected, incidental means and methods, and safety

precautions and programs. These comments align with the opinions of the insurance experts. Most of them mentioned that the design firm does not typically have the contractual authority to usurp the decision-making of the contractor. Engineers are not typically responsible for jobsite safety, means, and methods. It is the contractor's responsibility rather than design professional services. They further explained that several designers' PL policies exclude the liability for contractor's selected means and methods. Wrap-up or contractor's commercial general liability will respond to incidents on the job site. The designer's PL policy will not bring any safety claims unless the incident is due to the designer's errors and omissions.

A legal expert said that the above description sounds like the PCE assumes responsibility for the contractor's construction means, methods, sequences, and processes. Still, he continued that this is not necessarily an uninsurable risk, but it will also depend upon the contract. One insurance broker suggested that the PCE report his/her objections about the constructor's selected means and methods to the state DOT. If the contractor disputes the objection, a state DOT or a Dispute Resolution Board will resolve it. Typically, design–build contracts define the process for issuing non-conformance reports. The PCE can be referred to follow the expected procedure. Also, the term "safe and sound" needs further elaboration.

5. **The Project Chief Engineer must have the authority to stop work on the Project if and when he/she knows or has reason to believe that any work does not meet the standards, specifications, or criteria established for the Project.**

Engineers typically do not accept the responsibility to stop work. By explicitly stating the stop-work authority, the PCE is expanding his or her responsibility. Authority to

stop work may be interpreted as the obligation to stop work and accept the jobsite safety responsibility. It may also be interpreted as the PCE needs to be present at the jobsite at all times. In summary, the authority to stop work needs to be clarified, as lawyers can interpret it differently.

Two insurance brokers expressed that assuming jobsite safety responsibility exposes engineering firms to a much broader liability. A lawyer representing the insurance broker mentioned a case law that some courts have held that the language of the engineer's contract may imply the designer is in charge of the work. In *Illinois Miller v. Dewitt*, the court ruled on whether the architect had the authority to order the work stopped when injuries occurred as a result of the collapse of a school gymnasium roof. The contract between the owner and the architects stated that the owner gives the architects "the authority to stop the work whenever such stoppage may be necessary to ensure the proper execution of the work." Thus, the architects had to exercise reasonable care and the right of duty to stop the work until the unsafe condition had been remedied. If the architects breached such a duty, they would be liable to these plaintiffs, who the breach could foreseeably injure. There were a rising number of safety cases and claims against engineering firms and architects simply because they had the authority to stop work.

More recently, the American Institute of Architects (AIA) standard agreement changed to remove jobsite safety responsibility from its contract explicitly. The AIA also removed any mention of "Stop Work Authority" from its standard contractual language. This change has helped significantly reduce the number of claims and protect architect/engineer (A/E) firms from potentially being pulled into claims. By including

sticker languages, such as stop-work authority, supervision, and safety responsibilities, the court distinguishes an architect's or engineer's duty to observe, supervise, or inspect the work to ensure construction tasks involve the means, methods, or procedures. Without that language in the contract, the court agrees with the engineer's inability to stop the work and does not consider the distinction between observing the construction process when determining that the engineer supervised the work and participated in ongoing activities.

However, an insurance broker mentioned that he is less concerned about assigning this task to the PCE. Another insurance broker suggested that the PCE's stop-work authority should be limited to just professional engineering practices, and all construction means, methods, and/or quality matters should be excluded. This makes the PCE's responsibility consistent with the typical PL policy coverage.

Similar to those insurance brokers mentioned above, a legal expert who practices law in Georgia responded that the PCE would not be any licensure or insurance problem because of having the stop-work authority. He further described that authority means the engineer has the right to stop the work if he or she knows or reasonably believes that the work does not meet the standards, specifications, or criteria established for the project. Here, a right allows the engineer to protect the work and workers if he or she sees something that is wrong. This is different from a duty to verify, confirm, or warrant that the work meets the standards, specifications, or criteria established for the project. As the PCE language absents a duty, having the stop-work authority would not be a significant issue.

6. **The Project Chief Engineer shall verify that qualified and appropriately licensed and registered specialty/discipline engineers sign and seal work products for a given item, element, or phase of the work as applicable, including the released for construction plans, as well as revisions on construction and shop drawings.**

   The PCE does not possess contractual privity with third parties who are delegated designers, general contractor's subcontractors, or a material supplier and/or manufacturer. The lack of contractual privity means that remedial measures will have to be through a separate chain of contracts and third parties. The lag in receipt, review and verification of engineering work product can create the potential for design, fabrication, and construction errors, omissions, and defects to manifest. One insurance broker suggested that "[t]he nature of this 'verification'" seems somewhat illusory. The PCE can arguably satisfy verification by simply confirming that the engineering work product possesses a seal and signature, which is a certification in-and-of-itself by the professional engineer possessed [of] the requisite qualifications and licenses to apply the seal and signature."

SUMMARY

The PCE is a relatively new position for the DB and P3 industry, so it is quite normal to see some reservations and confusion from the DB industry. Issues related to providing required insurance and bonding were raised in the past to some agencies. Still, they have not been materialized as a deal-breaker to sign and execute the contract successfully. For example, talk about VDOT's experience with the responsible charge engineer (RCE) and EIC that eventually design–builders accepted the role and signed the contract and provided the required insurance.

Several DB subject matter experts from all backgrounds—design consultants, general contractors, owner officers, and owner's representatives—believe this role can add value for an owner in complex megaprojects. One participant commented, "The owner does not want to go to many other people to seek answers. The owner will ask for the Project Chief Engineer."

It is, however, imperative to clearly differentiate the role of the PCE from other key personnel in the DB team, such as the design manager, EOR, independent quality manager, and design–build coordinator, to avoid any perception of redundancy. Most respondents suggested that there is some room to improve the RFP language to reduce any possible gaps between GDOT's expectations and the DB industry's understandings. Also, the DB contract language determines how the new role is actually executed, and consistency is critical.

In interviews with insurance experts, the research team found that the insurance industry understands the purpose of this new position. It would not be a problem to use an engineering firm's corporate PL policy to cover the PCE position. However, it should be noted that the PCE role is new, and assigned responsibilities are not typical for the design firm to accept in regular design–build projects. The PCE role needs to be considered in the context where there is a broader pressure on engineering firms from the hardening PL insurance market.

There are specific terms that may need further elaboration to avoid any misunderstandings. *Accuracy* and *adequacy* may imply a heightened standard of care. *Certify* may imply "warranty" and "guarantee" that are above the typical standard of care. *Safe and sound design* can be further defined. There may be an alternative approach to get what GDOT intends to achieve regarding the authority to stop work. Rather than explicitly assigning the authority to the PCE firm, GDOT

can expect the PCE to inform the agency about any deviations from the contract documents. This could be a solution for the concern raised by some engineering consulting firms.

Throughout a series of interviews, the research team encountered that the DB insurance market is hardening. The research team set separate interviews to obtain opinions from the insurance experts. Chapter 65 further discusses what causes the market solidification, what happens in the current situation, and how the industry can improve.

CHAPTER 5. INSURANCE MARKET CONDITIONS

OVERVIEW

Throughout the interviews, the research team observed emerging issues related to the fact that securing proper professional liability insurance for design firms has recently become challenging. Some transportation engineering consulting firms raised concerns about the access, price, limit, and coverage of professional liability insurance for their work. They mentioned that it has become increasingly difficult to purchase affordable E&O insurance for some design firms. The research team wanted to identify the main underlying reasons for the hardening insurance market for architecture and engineering firms and hoped to hear a more detailed explanation and elaboration from the experts. For the last interviewee working as an insurance underwriter, the researchers embedded a couple of questions related to the insurance market challenges in the interview protocol. For those six insurance experts interviewed earlier, additional follow-up interviews were conducted through an email and a video call. All six of those experts responded to additional questions related to the market challenges, and the insurance underwriter also provided comments.

The interviewees shared several documents, such as market insight, and the research team also investigated and reviewed more content related to the market challenges. Combining the qualitative data received from the interviewees with content analysis, this research was able to conclude what causes the market solidification, what happens in the current situation, and how the industry can improve.

CHALLENGES IN THE INSURANCE MARKET

The Hardening Insurance Market

According to the Marsh Global Insurance Market Index, global commercial insurance prices increased the most significant rate by 22 percent in the fourth quarter of 2020 (Marsh 2021). One lead insurer has warned that a 30 percent rate increase is anticipated to the prescriptive position they intend to assess against all significant A/E risks in the U.S. (Aon 2020c). It is vital to consider the booming construction industry growth to examine the root causes of the hardening insurance market. Following the increased demand in the construction industry for the past several years, the supply of the workforce in the construction industry has increased, leading to increased revenue of the A/E firms. Projects also continued to increase in size and complexity. Still, the insurance market favored the buyer because of the competition between insurance carriers that resulted in unreasonably and unsustainably low rates (Aon 2020a).

However, with more work comes more claims and higher risk profiles. The percentage of firms reporting more claims than the prior year rose from 17 percent in 2016 to 26 percent in 2017 and 30 percent in 2018 (Conley 2019). According to the survey conducted by Ames & Goughn (2020), claims activity rose as 40 percent of the insurers in 2019 reported a worsening of their claims experience. Their survey found an increase in severity, frequency, and expenses among those reporting negative changes in claims patterns (Ames & Gough 2020). Furthermore, most of these insurers indicated their losses increased by 10 percent (Clinehens 2020). Insurers are going to be hard-pressed to achieve significant rate increases.

The causes of claims are numerous and varied. Many claims directly result from the complexity of the projects, the inflexible price structure, and the contractual approach that transfers most of

the financial risks to the contractor (Levin 1998). Harmon (2004) asserted that construction claims are caused by the projects' size and duration, the complexity of contract documents, poor communication, limited resources, financial constraints, inadequate design, labor issues, and force majeure events. Hashem et al. (2014) found that 53 percent of claims are related to work scope, material control, bidding, control of work, progress and prosecution, obligation and responsibility, and payment. Aon's insurance market insight affirmed that some of the contributing aspects influencing the increase of claims are underbidding, a lack of qualified professionals, and the number of mega projects where the smallest of errors often causes a significant financial loss (Aon 2020a). The ACEC survey revealed that communication and third-party claims ranked the most significant factor in claims against design firms at 48 percent for each. Errors and omissions of a technical nature followed the third most significant factor at 42 percent (Conley 2019).

Professional Liability Insurance Market Condition

According to Aon's market insight, the trends in the PL market in the U.S. can be explained in six dimensions: pricing, limits, retentions, coverage, capacity, and losses (Aon 2020b). The PL insurance market experiences rate increases. PL insurance experiences the highest rate of increase that deviated from the average annual pricing changes (Marsh 2021). One interviewee explained that PL premium is increasing by about 15 percent. Another interviewee also mentioned that for one insured with PL policies with Lloyd's of London, the increase was even higher, more than 20 percent.

According to the survey conducted by ACEC, 11 out of 14 insurance carriers responded that they are experiencing particular exposures for design professionals that may lead to higher rate

increases than in recent years. The survey participants further explained that the leading causes are the heightened risk exposure and claim trends because the A/E firms engaged in higher risk project types (Conley 2019). With losses mounting, insurers focus on higher risk disciplines, projects, and geographic locations where they see more claims and higher claim severity (Clinehens 2020). The markets then began increasing rates and premiums to those clients with a poor loss (Aon 2020a). With the advent of larger claims, the insurance market is stiffening and this increases self-insured retentions (SIRs) (Aon 2020a).

An insurance strategy would remain consistent for at least 1 year considering their reinsurance treaty renewals. Still, insurance carriers have decided to reduce total limits being purchased because of reduced available capacity or premium savings (Aon 2020c, 2020b). Overall market capacity has dropped for annual practice and single-project policies. This trend continues with a year-over-year escalation in claim values and defense costs (Aon 2020b). One interviewee also mentioned that defense costs are increasing, and insurance carriers think they are no longer defending the clients because they cannot make profits. The PL policy could exclude indemnity endorsement in the future (Hatem 2020).

Design–Build Projects

Interviewees were asked to identify to what extent they believe that the popularity of the design–build project delivery system contributes to the insurance market solidification. All of the interviewees mentioned that design–build is not the only factor that leads to the hardening market. Still, one of the most significant contributing factors is the rapid development and use of the design–build delivery model in the U.S. construction industry. With a relatively short history

of design–build contracting in the U.S., it is still challenging to allocate the risks to the design–builder risks appropriately (Aon 2020c).

The root causes of these challenges are the standard of care and its associated flow-down problems. Design professionals and contracts have different standards to accomplish the work in the construction industry. The standard of design liability does not guarantee a successful outcome for service, while contractors usually imply a warrant that the result of their services will be a successful project (Friedlander 1998). In DB projects, the line of liability between professional design services and construction work is often blurred (American Bar Association 2009).

For example, according to the AIA design–build agreement between the owner and design–builder (AIA A141-2014), "The Design–Builder warrants that the Work will conform to the requirements of the Design–Build Documents and will be free from defects." Here, the contract defines the term *Work* to mean construction and design. In other words, design–builders hold the same warranty standards as contractors for both construction and design services. This often leads to an increased standard that the design professionals hold a stricter standard in a DB context than when there is a separate contract for design services in a design–bid–build contract (Friedlander 1998). Project owners often pressure design professionals to accept terms and conditions beyond the common law standard of care (Greengard 2019). If an engineer signs such an agreement, the firm is exposed to additional claims, penalties, and costs (ACEC Risk Management Committee 2014). According to the ACEC survey in 2019, only one insurance carrier explicitly mentioned that it provides design–build coverage. Three carriers explicitly said they do not provide design–build coverage, and that is slightly increasing, compared to the

previous year's results when only one said "no" (Conley 2019). The remaining 11 carriers did not answer this question (Conley 2019).

Another challenge relates to the project-specific design PL policy. In the DB environment, the contractor can file a direct claim against the designer because it lowers the bar for suits of alleged negligence against the designer (Ashuri et al. 2019). The design–builder may sometimes overuse project-specific PL coverages (Lee et al. 2020). The insurers providing project-specific PL policies have experienced significant losses and decided to cease or suspend underwriting project-specific PL coverage on DB projects (Hatem 2020). This limited capacity will result in the need for design–builders and their design professionals to require contractual limits of liability in significantly lower amounts than customarily and conventionally considered acceptable (Hatem 2020). If a project-specific policy becomes unavailable or limited, the design professional may need to rely on their practice PL policy to address professional liability risk and defend design–builder claims. This will result in higher deductibles, higher premiums, lower available coverage limits, or potential design–build exclusions in practice policy (Hatem 2020). Thus, the professional liability insurance market considers design–build as a high-risk factor.

AREAS OF IMPROVEMENT

The research team examined any areas of improvement that highway transportation agencies can use to facilitate the access of design firms to affordable professional liability insurance in design–build projects. First, the standard of care should be considered carefully. Public owners and the construction industry need to understand the standard of care and the limitations of professional liability insurance that do not trigger coverage for errors and omissions beyond a negligence-based standard of care. At the beginning of any potential business relationship

between public owners and design–builders, engineering firms should address the heightened standard of care if the contracts include the relevant languages. Project owners should understand that a perfect project may not exist, but taking insurable risks is considerable since insurance is a great tool to manage potential risks (Greengard 2019).

Besides professional liability insurance from design professionals on design–build projects, the state transportation agencies may require the contractor to hold a separate insurance policy to cover the contractor's professional liability. The contractor's professional liability policy addresses the insured's direct liability for performed professional services (Kalach et al. 2018). The contractor's protective professional indemnity (CPPI) is another option that indemnifies the owner or design–builder for loss or damage above the limits available from the underlying available design professional liability coverage (Kalach et al. 2018). Since the risks to design–builders are more significant, the designer's professional liability insurance policy per se may not be adequate to cover the design–build team members (ASCE 2013). These additional policies may reduce the burdens on the project-specific professional liability policy. Design professionals may not exhaust insurance coverage resulting from the claims filed by contractors, which may allow them to maintain an affordable policy for future design–build projects. In fact, the Arkansas and Texas DOTs require the design–builder to hold either contractor's professional liability insurance or CPPI, in addition to the design professional liability insurance.

One root cause that has made it challenging for design professionals to obtain affordable liability insurance for DB projects is the increased number of design–builder professional liability claims against their consulting engineers (Hatem 2019). The causes of claims underlie unfair risk allocation between owner and design–builder in DB delivery, and the fixed-price procurement exacerbates the problem. The construction industry has recently argued that fixed-price projects

are becoming unprofitable because government agencies are pushing too many risks to contractors (Rubin and Powers 2019). Since the design–builder cannot seek recourse against its upstream contracting partner, it flows down to the mechanism of a professional liability claim against its consulting engineer (Hatem 2019). Instead of transferring all the risks away from the owner, public owners should identify project-related risks and develop a risk management program to achieve a balanced approach to risk allocation (Gad et al., 2020, Rubin and Powers 2019).

Guidelines to improve the balanced risk allocation in DB projects can help alleviate burdens on the design–builder and facilitate the stable insurance market for design firms to obtain affordable design professional liability insurance. Emphasis on partnering can be a practical option as a risk mitigation strategy. DB or P3 systems inherently induce the need to work together for the mutual good of the project (Ernzen et al. 2000). The partnering concept ideas include increased communication, alignment of goals, and development of a dispute resolution system—those aligned with the fundamental philosophy of design–build represent single-point responsibility for the owner (Ernzen et al. 2000). Partnering effectively facilitates risk management and directly enhances risk management (Wang et al. 2016) by establishing a project charter and starting off the project with more alignment among all project team members.

SUMMARY

With the advent of larger projects, increasing claims have resulted in the insurance market solidification. In particular, more claims arise in design–build projects with under-design at the bid stage and insufficient contingencies by contractors. The insurance carriers have experienced increasing losses. Several markets began to reduce their capacity to commit to any professional

liability risk (Aon 2020a). Some insurers reported an increase in claims activity, which will affect how insurance underwriters assess a design firm's risk profile. This trend primarily affects the large and medium risks since carriers were under scrutiny as they look for ways to control the portfolio. For small risks, rate increase remained stable because a larger number of insurers are available in the market. One interviewee explained that professional liability is already the third largest expense that most design firms spend, followed by salaries and overhead. Thus, it is imperative to understand the current insurance market and facilitate the access of design firms to affordable professional liability insurance in design–build projects.

With respect to PCE implementation, the interviewees expressed concerns that if the design firm fulfills the PCE, it will expose itself and its corporation to risks it would not normally take on. In general, an engineering consulting firm can accept the PCE position; there may not be anything specific in the engineering firm's PL insurance policy that would preclude the design firm from taking on the role. Considering the breadth of the new role, the engineering consulting firm extends its liability such that it may put its PL policy at risk. For instance, a designer usually would not accept responsibility for the design–builder's own design works related to temporary structures. However, it is perhaps not an insurance issue, but rather an insured extending its liability and putting its PL policy at risk when it usually would not be.

CHAPTER 6. CONCLUSIONS

This study proposed a synthesis of emerging issues related to key personnel in the large and complex DB and P3 environments involving multidisciplinary actors. The overarching goal of this research project was to identify best practice guidance on defining the Georgia DOT's expectations from the design–build team in proactive management of design-related issues in the innovative project delivery environment. Increasing needs for a new leadership role were investigated, and the study determined the kinds of skillset and qualifications this position is required to have. The research team explicitly included the description of a PCE that was recently introduced in a GDOT RFQ.

To collect a rich amount of data, the research team conducted qualitative analysis and interviewed various professional groups specializing in transportation DB and P3 projects. Those professional groups include state DOT officers, highway contractors, design consultants, owner's representatives, legal experts, and insurance experts. To increase familiarity with the PCE position, the research team included the roles and responsibilities of the PCE that excerpted from the GDOT RFQ. The researchers first interviewed state DOT officers and then interviewed the industry experts, such as design consultants, highway contractors, owner's representatives, and legal experts. Finally, they followed up with insurance experts to understand the PCE implementation in the context of insurability.

Throughout the interviews with the state DOT personnel, interviewees were asked to indicate multidisciplinary engineering issues and engineering decision-making processes in megaprojects. The discussion further elaborated on the needs of a new leadership position, especially regarding the PCE position. Overall, most DOTs favored the idea of requiring the new position in large and

complex DB and P3 projects. Significantly, the PCE will add value for large and complex projects that need to strengthen the design manager's role. The PCE is required to have a unique set of skills both in design and construction. The pool of qualified personnel for the PCE position may be limited, which could add some challenges for design–build teams to find appropriate candidates for the position. Thus, the RFQ and RFP should clearly describe the responsibilities of the PCE and give special attention to the duties during the construction phase.

In the next step, the research team explicitly focused on identifying gaps between GDOT's expectations and industry understanding of the PCE roles and responsibilities. The industry experts were asked to address what they think about the responsibilities of the PCE and whether they have any questions about the related responsibilities. Several DB subject matter experts from all backgrounds—design consultants, general contractors, owner officers, and owner's representatives—believe this role can add value for an owner in complex megaprojects. However, to avoid any perception of redundancy, a clear definition between the role of the PCE and other key personnel in the DB team should be provided.

When it comes to insurability, the insurance experts commented that it would not be a problem to use an engineering firm's corporate PL policy to cover the PCE position. However, it should be noted that the PCE role is new, and assigned responsibilities are not typical for the design firm to accept in regular design–build projects. The PCE role needs to be considered in the context where there is a broader pressure on engineering firms from the hardening PL insurance market. A majority of the interviewees agreed that there are specific terms that may need further elaboration to avoid any misunderstandings. *Accuracy* and *adequacy* may imply a heightened standard of care. *Certify* may imply "warranty" and "guarantee" that are above the typical standard of care. *Safe and sound design* can be further defined. Several recommendations are

made to enhance the description of the PCE role and responsibilities in order to minimize any gaps in the understanding of the design–build industry professionals to fulfill this position.

Throughout the interviews, some interviewees raised attention to the insurance market. Securing proper professional liability insurance for design firms has recently become challenging. Thus, the research team conducted a separate set of interviews with insurance experts to identify the main underlying reasons for the hardening insurance market for architecture and engineering firms. With the advent of larger projects, increasing claims result in the insurance market solidification. Overall, most interviewees believed that design–build is not the only factor causing the hardening insurance market. With respect to PCE implementation, the interviewees expressed concerns that if the design firm fulfills the PCE, it will expose its corporate professional liability policy to risks it would not normally accept in regular design–build projects. Still, some interviewees mentioned that it is not an insurance issue but rather an insured extending its liability and putting its PL policy at risk when it usually would not be. The current engineering firm's PL insurance does not preclude the design firm from taking on the PCE role.

Throughout the series of interviews and content analysis, the viability of the PCE role and its importance was evident. As the projects become larger and more complex, multidisciplinary parties are required to participate in the projects. State DOTs need somebody at a high-level decision-making position in the DB team to protect the public interests overall in the practice of engineering. It is anticipated that the PCE can empower different design disciplines to take the lead at the appropriate times and ensure that all others, especially people on the construction side, align with the appropriate engineering decision-making process. The PCE can become a go-to person in the DB team with whom state DOTs can discuss all engineering-related issues within the appropriate engineering standard of care. These findings do not limit their scope only

to the PCE implementation. Instead, these are considerable areas of improvement to elevate the state of engineering decision-making and advance design and construction integration in innovative program delivery.

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