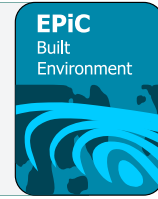




EPiC Series in Built Environment

Volume 6, 2025, Pages 883–892

Proceedings of Associated Schools of Construction 61st Annual International Conference



Exploring the Variability in Quality Management Roles and Responsibilities in State DOT Design-Build Projects

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Quality management is a broad discipline involving a range of responsibilities that can vary significantly across construction projects. In design-build (DB) projects, this complexity is heightened as the DB team oversees both design and construction, as well as ensuring compliance with project requirements. The overarching goal of this study is to examine the key personnel requirements related to quality management roles, focusing on the roles and definitions of quality management positions. This study conducts a comparative content analysis of the requests for qualifications from the state Department of Transportation (DOT). The findings show a growing trend among DOTs to require independent quality managers, often third-party professionals, responsible for quality assurance. Additionally, there is notable variability in how DOTs allocate quality responsibilities. Some mandate separate quality managers for design and construction, while others specify a construction quality manager focused on materials and workmanship. This variability can result in ambiguity about role expectations. By clarifying the distinct responsibilities of various quality management roles, this study offers industry professionals practical guidance to enhance alignment and improve project outcomes in DB projects.

Keywords: Quality Management, Quality Control, Quality Assurance, Design-Build

Introduction

The success of construction projects is often measured by the degree to which project outcomes meet the expectations and satisfaction of stakeholders (Ashokkumar, 2014). It is also linked to the delivery of high-quality material products (Wawak et al., 2020). Effective quality management in construction ensures that materials and workmanship meet specified standards, directly influencing project timelines, costs, and long-term operational performance (Kissi et al., 2019). The challenges of maintaining consistency and accountability across the design, construction, and handover phases underscore the importance of implementing robust quality management practices (Gransberg & Molenaar, 2004).

In the traditional design-bid-build (DBB) project delivery method, the responsibilities for design quality and construction quality are distinctly defined, with the design team accountable for creating

quality plans and specifications, while the construction contractor is responsible for executing the work according to those plans (Nguyen et al., 2018). This clear separation of roles fosters a structured quality management process, minimizing overlap between the design and construction teams. Such delineation helps ensure that each phase of the project adheres to established quality standards, ultimately contributing to project success.

However, alternative delivery methods, such as design-build (DB), introduce unique challenges because the contractor is responsible for both design and construction. This blending of roles necessitates a more integrated and collaborative approach to quality management, which can lead to confusion or ambiguity in defining responsibilities (Liu et al., 2022). Ensuring compliance with regulatory requirements, such as the Davis-Bacon Act for labor standards and Disadvantaged Business Enterprise (DBE) goals, adds further complexity, especially since the DB contractor should manage compliance for both the design and construction phases.

A critical issue in DB projects is the variability in the roles and responsibilities of quality management personnel. State departments of transportation (DOTs) impose diverse requirements for quality managers, leading to inconsistencies in the structure and implementation of quality management practices. These inconsistencies make it challenging for design-build contractors to standardize their quality assurance and control processes across projects governed by different authorities. Additionally, there are concerns about the development of effective quality management systems without access to complete design and quantity data (Jallan et al., 2018). The lack of standardized terminology and organizational structures across state DOTs further complicates communication among stakeholders. Thus, understanding current practices, including the responsibilities and qualifications required for quality management roles, is essential for improving consistency and effectiveness in DB projects.

Literature Review

Prior studies have highlighted several areas of inconsistency, particularly in how state transportation agencies assign quality-related responsibilities to project stakeholders. These variations complicate the expectations for quality management and can hinder consistent project outcomes (Lee et al., 2022). This highlights a need for research aimed at clarifying and aligning quality roles in DB projects.

Gransberg & Molenaar (2008) identified that, unlike in traditional DBB projects where DOTs maintain substantial control over quality assurance (QA) and quality control (QC), DB projects often shift these responsibilities to the DB team. This transfer results in less oversight from the highway agency and a more proactive quality role for the DB contractor. However, this shift has led to inconsistent QA practices, as states adopt varying degrees of oversight and accountability, often without clearly defined boundaries between QA and QC roles (Ashuri et al., 2021).

The challenge of variability is further compounded by the practice of contracting independent quality firms to oversee QA. Jallan et al. (2018) and Lee et al. (2020) noted that many DOTs hire construction quality acceptance firms (CQAFs) or independent quality firms (IQFs) to maintain quality standards without contractor influence. While this model aims to ensure objectivity, studies indicate that the roles of these third-party firms are often ambiguously defined, with responsibilities varying widely across projects and states. This ambiguity in the assignment of QA responsibilities creates confusion and diminishes accountability (Liu et al., 2022).

Further studies highlight inconsistencies in the requirements for quality assurance plans (QAPs) across DOTs. In some states, DOTs require DB teams to adhere strictly to established QA guidelines, while others permit the DB teams to propose custom QAPs (Scott & Molenaar, 2017). This flexibility in QAP requirements enables DOTs to tailor quality approaches to specific project needs but also leads to discrepancies in role expectations and QA standards. According to Gransberg et al. (2008), such discrepancies can result in miscommunication and unclear accountability, especially where responsibilities overlap or diverge between DOTs and contractors.

Gad et al. (2015) further underscored the urgency of this issue, noting that while state DOTs increasingly recognize the importance of robust quality management in DB projects, the lack of uniformity in QA/QC roles persists. They observed that some DOTs are more proactive in defining these roles, while others lack clear guidance, leaving DB teams to navigate vague or incomplete expectations and leading to variations in project outcomes.

Moran et al. (2024) contributed to the discussion by examining the misalignment between owner expectations and quality criteria in RFPs for DB transportation projects. Their study highlights that schedule and budget often dominate selection criteria, but quality control and assurance are frequently deprioritized. In their other research on procurement challenges for large-scale DB mega bridge projects, Moran et al. (2021) found that inconsistencies in scoring criteria and an overemphasis on price often overshadow the importance of quality and technical expertise in DB megaprojects. These findings reinforce the need for a standardized and transparent approach to quality management and procurement criteria in DB projects, suggesting that aligning quality expectations from the onset could improve consistency, reduce disputes, and ensure project outcomes meet owners' standards and needs.

Mohamed & Tran (2022) also highlighted the importance of tailoring QA approaches to specific project characteristics, such as material type, rather than relying solely on complexity. Their findings emphasize that qualified quality managers need to differentiate QA methods according to material requirements, such as project-produced, plant-produced, or standard manufacture, each demanding unique inspection techniques. This underscores the need for quality managers with specialized expertise who can adapt QA roles and responsibilities to suit project-specific attributes and ensure a more precise and effective quality management approach in DB projects.

Previous studies underscore the critical need for clarity and standardization in quality management practices within DB projects. While previous research has broadly explored quality management practices, our study narrows its focus to examine the specific roles, responsibilities, and qualifications of quality managers across state DOTs. This targeted approach aims to address gaps in understanding how quality management personnel are utilized and the qualifications required for both design and construction quality management within DB projects. By concentrating on the distinct requirements set by various state DOTs, our research seeks to provide a more detailed framework that can guide standardization efforts and support consistency in quality management practices.

Research Methodology

To analyze the key personnel requirements related to quality management in state DOT requests for qualifications (RFQs), this study conducted a comparative content analysis of the language regarding quality managers used in key personnel requirements from RFQs. A thorough search was conducted on each state DOT website to identify relevant sections dedicated to procurement, contracts, or project information. This initial search yielded 58 RFQs from 16 state DOTs, covering the period from January 2018 to December 2023, all of which were publicly accessible through archival data. As

shown in Table 1, 10 projects across 10 state DOTs that included a quality manager as key personnel were selected for in-depth analysis.

Table 1. RFQ Reviewed for the Content Analysis

Project Name	Estimated Cost	State DOT
Van Wyck Expressway	\$650 to 750 million	New York
I-55 Corridor	\$246 million	Missouri
Phoenix-Casa Grande (I-10)	\$250 million	Arizona
I-64 Hampton Roads Express Lanes	\$318.5 million	Virginia
I-285 / I-20 West Interchange	N/A	Georgia
I-35 NEX South	\$630 million	Texas
Carolina Crossroads Phase 3	N/A	South Carolina
I-69 Reconstruction Southwest and University Regions	N/A	Michigan
IS-695 from IS-70 to MD 43	\$100 million	Maryland
Brent Spence Bridge Corridor	\$3.1 Billion	Ohio

We utilized NVivo version 14, a computer-assisted qualitative data analysis software (CAQDAS), to ensure systematic analysis and effective data management. Qualitative coding was systematically applied to each document, with periodic intercoder reviews to ensure coding reliability across the research team. Figure 1 indicates nine codes: (1) Creating QA/QC Plan, (2) Executing QA/QC Plan, (3) Design Compliance, (4) Compliance with Construction Specifications, (5) Licensure, (6) Past Projects, (7) Years of Experience, (8) Relevant Experience, and (9) Affiliation. The research team then further grouped the nine codes into two categories: (1) Qualification and (2) Responsibility. This categorization facilitated the analysis of patterns and trends in the language related to quality managers. Through the analysis, this study identified key areas where state DOTs differ in their approaches to setting quality management requirements.

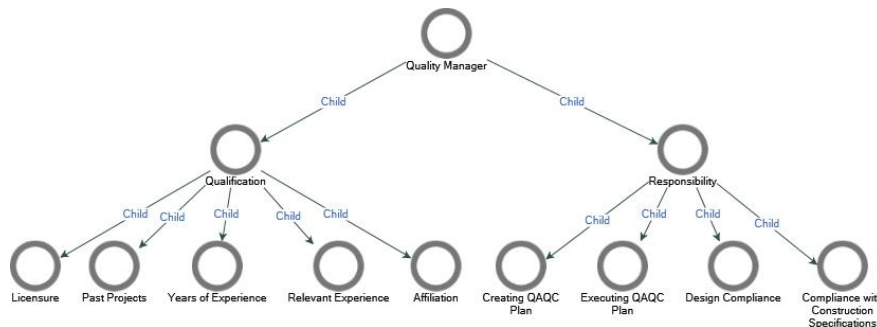


Figure 1. Responsibilities and Qualifications Related to Quality Manager

Findings

This research aimed to identify differences in requirements and the responsibilities for quality management among DB projects authorized by state DOTs. As shown in Figure 2, there are diverse quality management roles across different DOTs. While some DOTs require a quality manager

responsible for overseeing both design and construction phases, other DOTs have separate roles dedicated specifically to construction or design quality only. This variation reflects differing approaches to quality oversight in design-build projects. Interestingly, some states, such as Georgia DOT, incorporate multiple quality roles across different phases (i.e., quality assurance, construction, and design) indicating a comprehensive approach that spans both assurance and control functions. Additionally, the presence of roles like independent quality manager (South Carolina DOT), independent design quality management manager (Michigan DOT), and independent design quality firm manager (Virginia DOT) suggests a trend in some DOTs toward independent oversight to promote impartiality and compliance.

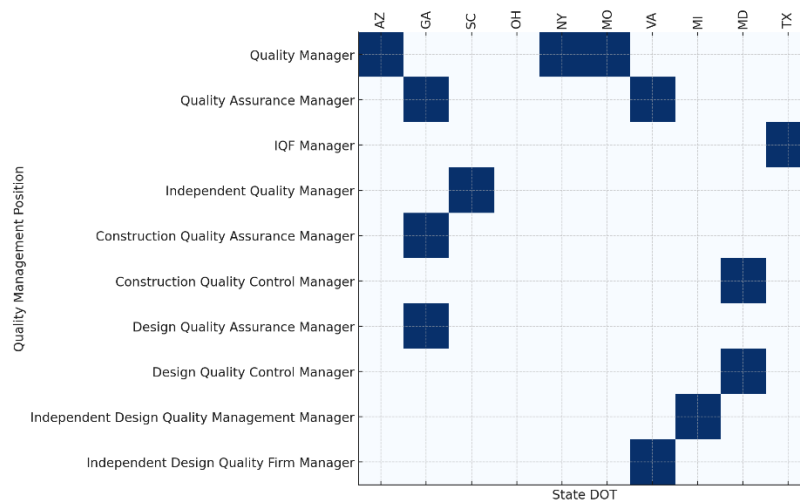


Figure 2. Distribution of Quality Management Roles Across State DOTs

While overall quality manager or quality assurance manager roles are commonly required, the roles of construction quality manager and design quality manager are less frequently specified, reflecting differences in how state DOTs prioritize quality management across various project phases. Given this variation, there may be an opportunity to standardize certain quality management roles to enhance consistency in DB project oversight. DOTs emphasizing independent quality management may benefit from sharing best practices with other agencies to strengthen impartiality in quality oversight. DOTs with overlapping roles across categories, like Georgia DOT, could also benefit from clearer role definitions and scopes to avoid redundancy and ensure efficient quality management practices.

Table 2 provides an overview of quality management roles and their assigned responsibilities across various state DOTs in DB projects. These responsibilities include *Creating QA/QC Plan*, which involves developing a QA/QC plan to set quality standards and processes for the project; *Executing QA/QC Plan*, which refers to the actual implementation of the QA/QC plan to ensure compliance throughout the project phases; *Design Compliance*, focusing on verifying that the design adheres to project specifications and requirements; and *Compliance with Construction Specifications*, ensuring that construction activities meet the required standards and specifications.

Table 2. Quality Management Roles and Responsibilities Across State DOTs

	Responsibility
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Position	State DOT	Creating QA/QC Plan	Executing QA/QC Plan	Design Compliance	Compliance with Construction Specifications
Quality Manager	Missouri	✓	✓	✓	✓
	New York	✓	✓	✓	✓
	Arizona	✓	✓	✓	✓
Quality Assurance Manager	Georgia		✓	✓	✓
	Virginia		✓		✓
IQF Manager	Texas		✓		✓
Independent Quality Manager	South Carolina		✓		✓
	Georgia		✓		✓
Construction Quality Assurance Manager	Georgia		✓		✓
Construction Quality Control Manager	Michigan		✓		✓
Design Quality Assurance Manager	Georgia		✓	✓	
Independent Design Quality Management Manager	Maryland		✓	✓	
Independent Design Quality Firm (IDQF) Manager	Ohio		✓	✓	
Design Quality Control Manager	Michigan		✓	✓	

The quality manager role, for instance, is tasked with comprehensive responsibilities in Missouri, New York, and Arizona, covering all aspects of quality management, including creating and executing the QA/QC plan, design compliance, and construction specifications compliance. This suggests that these DOTs expect the quality manager to oversee both the design and construction phases, providing a holistic approach to quality oversight. Additionally, several roles are assigned to independent quality managers, emphasizing impartiality in oversight. For example, South Carolina DOT's independent quality manager and Ohio DOT's independent design quality firm (IDQF) Manager are primarily responsible for compliance-related tasks. This trend indicates that some DOTs prioritize independent verification in key areas of quality management to enhance objectivity and compliance. In some cases, DOTs adopt highly specialized roles tailored to particular responsibilities. For example, Michigan's construction quality control manager and design quality control manager focus exclusively on executing the QA/QC plan and ensuring compliance with construction specifications. This specialization suggests that Michigan's DOT emphasizes targeted quality oversight in both construction and design, potentially to maintain stricter standards within each phase.

Table 3 outlines the qualifications required for various quality management roles across state DOTs in DB projects. Each position is listed alongside the corresponding state DOT, with columns defining key qualification criteria, including licensure, past project experience, years of experience, relevant experience, and whether the role is independent. These criteria provide insight into the differing requirements for quality management personnel across states. One trend evident is the emphasis on

licensure for certain roles. Several positions, such as the quality assurance manager in Virginia DOT, the IQF manager in Texas DOT, and the independent quality manager in South Carolina DOT, require licensure as a registered professional engineer (PE). This requirement suggests that DOTs value the technical expertise and regulatory understanding that licensed engineers bring to quality management roles, especially those with direct oversight responsibilities. There is also variability in experience requirements across roles, with most positions requiring between 5 to 25 years of experience. Additionally, most of the positions, except for the Virginia DOT, specify the need for relevant experience, suggesting that DOTs seek candidates with specialized knowledge in quality management or related fields to ensure preparedness for the demands of these roles. Relevant experience requirements vary based on the specific focus of each DOT. The findings highlight the emphasis on independence for certain quality management roles. These roles underscore the importance of unbiased oversight in quality management.

Table 3. Qualifications for Quality Management Roles Across State DOTs

Position	State DOT	Qualifications				Affiliation
		Licensure	Past Projects	Years of Experience	Relevant Experience	
Quality Manager	Missouri			5 years	✓	
	New York			25 years	✓	
	Arizona	Registered PE		25 years	✓	
Quality Assurance Manager	Georgia		✓	5 years	✓	
	Virginia	Registered PE				Independent
IQF Manager	Texas	Registered PE	✓	5 years	✓	Independent
Independent Quality Manager	South Carolina	Registered PE	✓	15 years	✓	Independent
Construction Quality Assurance Manager	Georgia	Registered PE	✓	10 years	✓	Independent
Construction Quality Control Manager	Michigan			10 years	✓	
Design Quality Assurance Manager	Georgia	Registered PE	✓	7 years	✓	Independent
Independent Design Quality Management Manager	Maryland	Registered PE		15 years	✓	Independent
Independent Design Quality Firm (IDQF) Manager	Ohio	Registered PE		8 years	✓	Independent
Design Quality Control Manager	Michigan	Registered PE		10 years	✓	Independent

Table 4 further elaborates on the examples of relevant experience required for different quality management roles. Relevant experience requirements vary based on the specific focus of each DOT. For example, the quality manager role in Missouri DOT requires experience in heavy civil construction, while New York State DOT emphasizes quality management, assurance, and control in general. Furthermore, the New York State DOT requires a quality manager role with experience in field engineering & inspection of bridges and infrastructure. Some positions specify experience in managing or coordinating large-scale, complex projects. For example, the quality manager in Arizona DOT needs experience in complex highway infrastructure, with a focus on managing quality programs on freeways and design-build management of major freeways. Overall, the findings indicate a broad range of relevant experience requirements for quality management roles across state DOTs, tailored to the unique needs of each position and the infrastructure focus of each state. DOTs commonly value experience in managing quality for transportation infrastructure, particularly highways and major civil projects.

Table 4. Examples of Relevant Experience Required for Quality Management Roles

Position	State DOT	Examples of Relevant Experience
Quality Manager	Missouri	<ul style="list-style-type: none"> • Heavy Civil
	New York	<ul style="list-style-type: none"> • Quality Management, Assurance, Control • Project Management • Design of Bridges, Highways, Civil Infrastructure • Field Engineering & Inspection of Bridges/Infrastructure
	Arizona	<ul style="list-style-type: none"> • Complex Highway Infrastructure Coordinating & Managing Quality Programs on Freeways • Design-Build Management of Major Freeways
Quality Assurance Manager	Georgia	<ul style="list-style-type: none"> • Quality Manager on Transportation Infrastructure Projects
IQF Manager	Texas	<ul style="list-style-type: none"> • Quality Management
Independent Quality Manager	South Carolina	<ul style="list-style-type: none"> • Quality Acceptance of Highway Transportation Projects
Construction Quality Assurance Manager	Georgia	<ul style="list-style-type: none"> • Highway Transportation Infrastructure Construction
Construction Quality Control Manager	Michigan	<ul style="list-style-type: none"> • Highway Construction Projects
Design Quality Assurance Manager	Georgia	<ul style="list-style-type: none"> • Quality Assurance Manager, Lead Designer, or Engineer of Record
Independent Design Quality Management Manager	Maryland	<ul style="list-style-type: none"> • Relevant Experience
Independent Design Quality Firm (IDQF) Manager	Ohio	<ul style="list-style-type: none"> • Quality Management
Design Quality Control Manager	Michigan	<ul style="list-style-type: none"> • Highway Construction Projects

Conclusion

In conclusion, the analysis of quality management practices across various state DOTs in DB projects reveals significant variability. While some states, such as Arizona and New York State DOTs, demand extensive experience of up to 25 years for their quality managers, others have less stringent requirements. The necessity for a QA/QC Plan is also not uniform, with only Missouri, New York, and Arizona DOTs mandating its creation. Additionally, the requirement for quality managers to be professional engineers is not consistent across all states, with 4 out of 13 quality management personnel not imposing this criterion. The role of independent firms in quality management also varies, with all design quality manager positions requiring association with an independent firm, compared to only a portion of quality manager positions. Furthermore, the experience required for quality management roles can be specific to quality or more broadly related to the complexity and scope of the project.

These differences highlight the diverse approaches to quality management in DB projects across state DOTs, reflecting varying priorities and regulatory environments. This variability underscores the importance of understanding state-specific requirements and adapting quality management strategies to ensure compliance and project success. However, to enhance the effectiveness and consistency of quality management in DB projects, there is a compelling need for more universal standards across state DOTs. Establishing uniform quality management requirements would help streamline processes, reduce confusion, and ensure a higher and more consistent level of quality across all projects. This universal approach would not only facilitate better project outcomes but also promote fairness and efficiency in the management of public infrastructure projects nationwide.

This research's findings will contribute to knowledge of quality management in DB projects, particularly in the context of DOT highway projects. By identifying trends, ambiguities, and variations in quality management roles across state DOT RFQs, the study will help DOTs and industry professionals better define and align their quality management frameworks. This alignment is critical for improving the efficiency and success of DB projects, leading to higher-quality project outcomes and better resource management.

Acknowledgments

This project was funded by Roger Williams University's Foundation to Promote Scholarship and Teaching.

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