SHRP 2 Renewal Project R07

Implementation Guidelines
Volume I

Strategies for Implementing Performance Specifications: A Guide for Executives and Project Managers

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SHRP 2
STRATEGIC HIGHWAY RESEARCH PROGRAM
Accelerating solutions for highway safety, renewal, reliability, and capacity

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

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SHRP 2 RENEWAL RESEARCH

Performance Specifications for Rapid Highway Renewal

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PERFORMANCE SPECIFICATIONS FOR RAPID HIGHWAY RENEWAL

IMPLEMENTATION GUIDELINES

VOLUME I

Strategies for Implementing Performance Specifications: A Guide for Executives and Project Managers

Prepared for
Strategic Highway Research Program 2
Transportation Research Board
of
The National Academies

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PREFACE

Transportation agencies are under increasing pressure to improve mobility while maintaining existing facilities with limited resources. In response to this pressure, agencies have begun experimenting with ways to accelerate construction and minimize disruption while improving mobility, safety, and long-term performance. To help advance such initiatives, Congress established the second Strategic Highway Research Program (SHRP 2) in 2006 to pursue research in four focus areas: safety, reliability, renewal, and capacity.

The renewal area looks at improving the aging and increasingly congested transportation infrastructure through design and construction methods that will accelerate construction, cause minimal disruption to road users and the community, and produce long-lasting facilities. Recognizing that traditional method specifications can act as a barrier to the innovation often needed to achieve these objectives, SHRP 2 Project R07 was tasked with developing performance specifications that could be used to motivate and empower the contracting industry to provide creative solutions to save time, minimize disruption, and enhance durability.

Despite the potential advantages offered by performance specifications, they will not emerge as a viable alternative to traditional method specifications overnight. For agency personnel, developing and implementing a scope of work in terms of user needs and end-result performance is often much more challenging and resource-intensive than simply adhering to the agency's standard specifications. For contractors, an initial investment may be needed to acquire the necessary knowledge, skills, and equipment to assume more responsibility for performance.

As an outgrowth of the SHRP 2 R07 research effort, the following guidance document has therefore been prepared to address the various cultural, organizational, and legal considerations that can affect the successful implementation of performance specifications.

An equally important component of an overall implementation strategy – specification development – is addressed in detail in Volume II of these Guidelines. Readers are encouraged to review this companion document for further information on how performance specifications can be developed and tailored to help achieve project goals.

Executive Summary

This Volume, Strategies for Implementing Performance Specifications, is designed to provide a broad overview of the benefits and challenges associated with implementing performance specifications. Recommendations are provided regarding the various cultural, organizational, and legal considerations that can affect the successful implementation of performance specifications. Project selection criteria and procurement and project delivery options are also addressed. The anticipated benefits of these guidelines are:

- Improved decision making leading to more effective implementation of performance specifications
- Improved understanding of the required changes in contract administration associated with performance specifications and alternative project delivery methods
- Smoother transition to a more performance-oriented business model

In general, performance specifications have been demonstrated to be a powerful tool to motivate and empower the industry to improve project performance or value. One of the most significant benefits reported in the literature and confirmed by discussions with industry experts is the ability of performance specifications to promote construction innovation. The ability to innovate can provide contractors with a competitive advantage, which can ultimately lead to cost savings and greater returns. Benefits, or value added, from using performance specifications are more likely to be realized if the contractor becomes involved in a project early and assumes more responsibility for performance. This value added is contingent upon owners selecting appropriate projects and defining key performance criteria and measures that align with project objectives. Value is also affected by the duration of the contractor's responsibility for performance.

Performance specifications will not immediately emerge as a viable alternative to traditional method specifications. Agencies and industry may find it easier to manage the changes in business practices required for performance specifications in steps or increments. The following guidelines have been developed to help agencies and industry with this transition. The key elements outlined in these guidelines include the following:

Organizational Considerations. Agencies should communicate the need and advantages of transitioning to performance specifications to internal agency staff and develop an action plan for implementing performance specifications. The plan could include establishing a dedicated crossfunctional internal team, developing criteria for screening and selecting projects, identifying changes in roles and responsibilities and standard administrative procedures, providing internal training, developing sample specifications, conducting trial projects, and evaluating lessons-learned.

Industry Considerations. Agencies should engage industry early to highlight changes in roles and responsibilities, risks, and rewards related to performance specifications. Responsibilities may include design, construction quality management, and post construction performance (contingent upon contracting method). Risks may include managing subcontractor and supplier relationships to meet performance requirements, and providing bonds, insurance or other guarantees of performance for long-term performance obligations. Rewards might include the ability to use innovative methods, materials or technology, or the ability to earn incentives for improved performance. Collaborating with industry in the development of performance specifications will help balance the risks and lead to smoother implementation.

Deciding to Use Performance Specifications. This guide includes a two-part decision process to determine if performance specifications are an appropriate fit for a given project. The project selection process considers project characteristics, goals and objectives, and whether the objectives can be defined in terms of desired performance outcomes that can be measured and tested in the finished product or measured over a specified operational period. The decision will determine whether the project is a good candidate for method or performance specifications for specific project objectives (e.g. time, quality, service life). The second step evaluates whether the project is a candidate for alternative delivery methods that would allow industry greater flexibility to achieve performance outcomes and that would transfer more responsibility to industry for performance. The project delivery options range from traditional design-bid-build to design-build-operate-maintain.

Project Delivery and Procurement Considerations. The decision to use performance specifications in conjunction with a project delivery system requires the agency to consider both the procurement process and how performance specifications will be implemented to meet performance objectives. The choice of delivery approach will result in different procurement approaches, performance parameters, and levels of performance risk assumed by industry. This guide considers how performance specifications will vary with project delivery method and presents various alternatives to the traditional procurement process that align with project objectives, and how payment adjustment strategies can be used to motivate contractors to improve quality and performance.

Chapter 1

Introduction to Performance Specifications

1.1 Performance Specifications: Why Now?

1.2 What are Performance Specifications?

1.3 Performance Specifications and other Performance Management Initiatives

1.4 Rationale for Using Performance Specifications

1.5 Advantages and Disadvantages of Method and Performance Specifications

1.6 Overview and Organization of Manual

Chapter Objectives

This chapter:

- Defines performance specifications and the role they play in an overall performance contracting strategy
- Identifies the rationale for using performance specifications
- Compares the advantages and disadvantages of method and performance specifications

1. Introduction

1.1 Performance Specifications: Why Now?

Societal changes and economic conditions suggest that the traditional way of delivering highway construction projects may no longer be sufficient to keep pace with the growing demands placed upon our highway system to move people and goods safely and efficiently. Recent infrastructure report cards indicate that the system is deteriorating and facing increasing congestion. At the same time, state highway agencies are facing shrinking budgets and dramatic reductions in both the numbers and experience levels of inspectors and engineers. The complexity of high-speed construction, nighttime construction, and rehabilitation work under traffic—all of which the public demands—further stretches available agency resources.

In response to this widening gap between investment needs and available resources, several agencies have begun experimenting with alternative specifications and contracting strategies that place more responsibility for performance on the private sector. The traditional way of doing business, using low bid contracting and prescriptive requirements that tell the contractor how to perform the work, does not motivate the contractor to provide more than the prescribed minimum. The addition of performance specifications to an agency's toolbox would provide the means to motivate and empower contractors to find creative solutions to save time, minimize disruption, and/or enhance safety and quality in the interest of rapid renewal.

> *"To attain our goals of quality, improved product performance, and a better environment for contractor innovation, we cannot simply identify and test those construction and materials factors that best determine product performance. We also must address roles, responsibilities, risks, and specification language, as well determine how best to deliver that product. Freedom to innovate with accountability to deliver is the driving force behind the performance specification movement."*
>
> FHWA Performance Specifications Strategic Roadmap, 2004

1.2 What are Performance Specifications?

As used in this document, the expression "performance specifications" serves as an umbrella term, encompassing various non-traditional specification types used or proposed for use in the highway construction industry, including end result specifications, quality assurance (QA) specifications, performance-related specifications (PRS), performance-based specifications (PBS), and warranty and long-term maintenance provisions. (For more detail on these different specification types, refer to Volume II, Chapter 1 of these Guidelines.)

In general, these specification types represent a progression towards increased use of higher level acceptance parameters that are more indicative of how the finished product will perform over time. To varying degrees, they all attempt to shift more performance risk to the contractor in exchange for limiting prescriptive requirements related to the selection of materials, techniques, and procedures. By relaxing such requirements, performance specifications have the potential to foster contractor innovation and thereby improve the quality or economy, or both, of the end-product.

Figure 1.1 places these specification types along a continuum of increasing contractor responsibility for performance. At one end of this continuum are the traditional method specifications through which the agency will retain primary responsibility for end-product performance. Moving along the continuum, performance specifications that allow for quality price adjustments based on end-result testing or predictive models begin to shift more performance risk to the contractor. At the other extreme are post-construction performance provisions that are designed to monitor and hold the contractor accountable for *actual* performance *over time*.

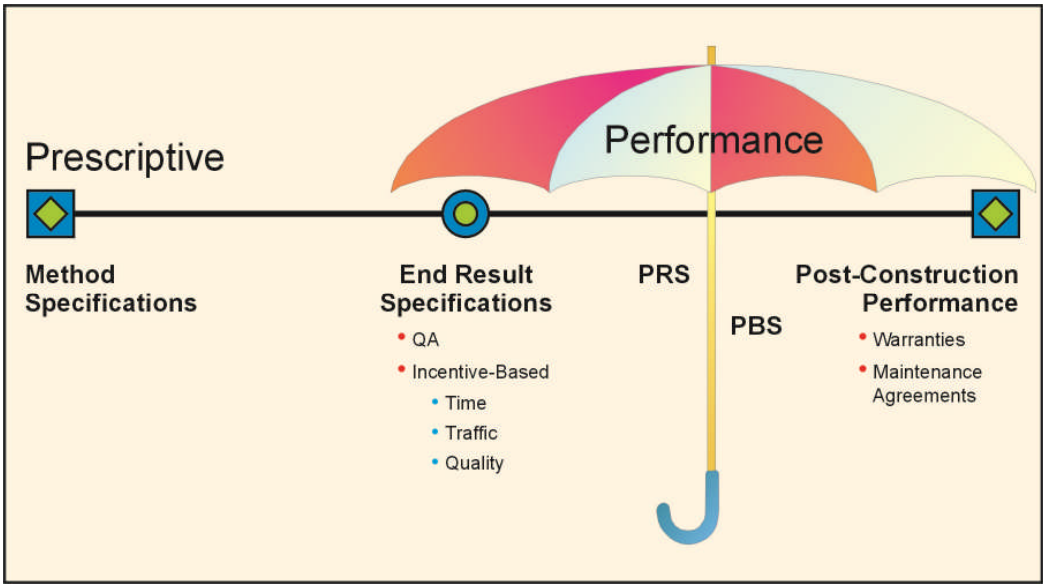

Figure 1.1: Continuum of Highway Specifications

As depicted in Figure 1.2 and discussed in greater detail in subsequent chapters, performance specifications can also be thought of as an integral component of an overall performance contracting system, in which a project's specifications, contract delivery method, and procurement approach are all tailored to one another and to achieving the project goals. The performance specification should translate user needs and project goals into measurable acceptance parameters. The chosen contract delivery method and its inherent conventions regarding design, construction, and post-construction maintenance responsibilities should be consistent with the risk allocated to the contractor in the specifications for achieving these goals. Likewise, the procurement approach should ensure the selection of a qualified contractor capable of meeting the performance objectives.

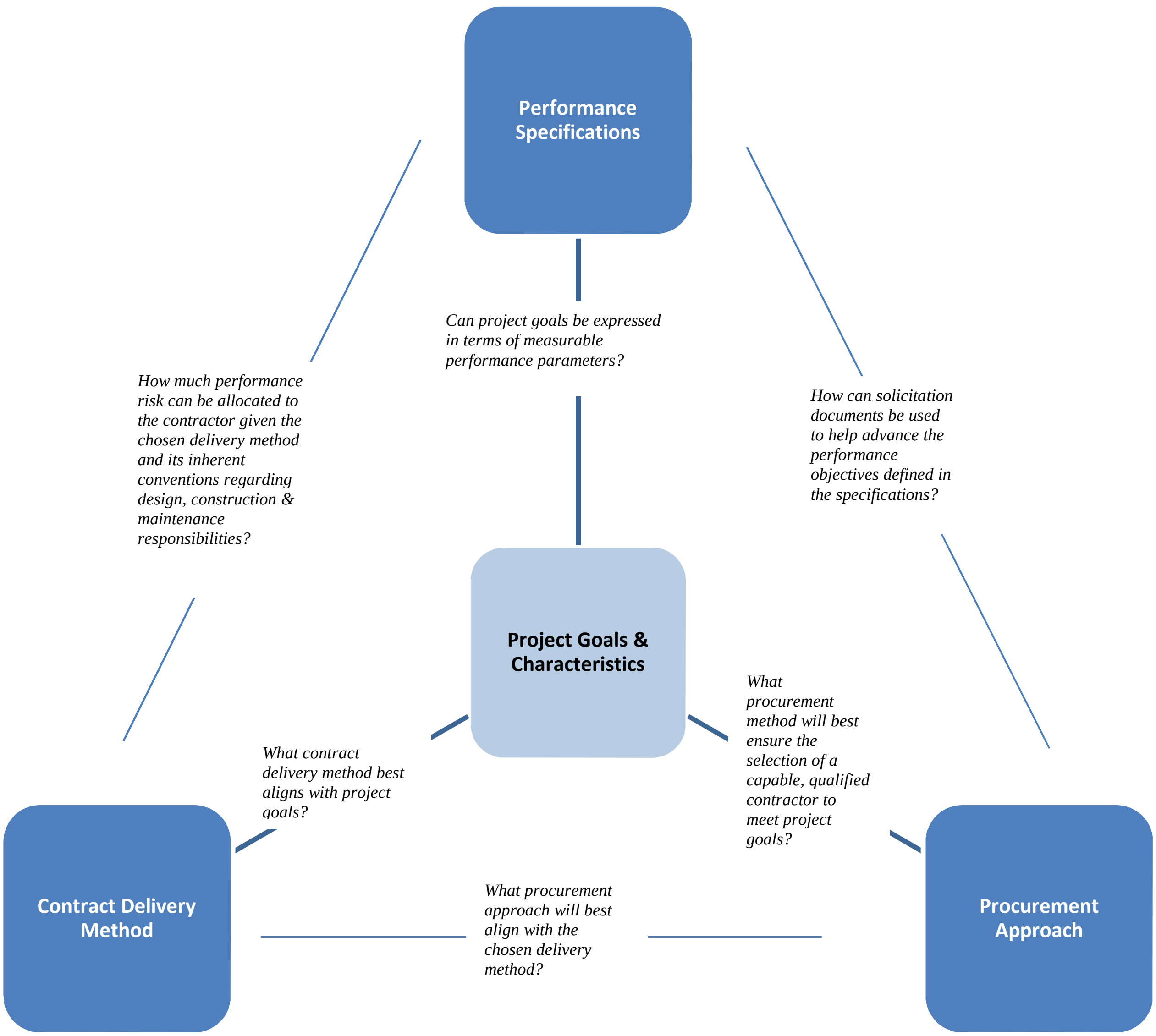

Figure 1.2: Performance Contracting System

1.3 Performance Specifications and other Performance Management Initiatives

It may be possible to coordinate the implementation of performance specifications with other on-going performance management initiatives. For example, AASHTO is a strong advocate for the use of performance-based management within highway agencies as a means of advancing national interests related to system preservation and maintenance, mobility and connectivity, interstate commerce, safety, and the environment (AASHTO 2003, 2008). Similarly, a key aspect of Moving Ahead for Progress in the 21st Century Act (MAP-21) is the transition to a performance or outcome-based program. At the federal level, performance management will provide a means to more efficient investment of Federal transportation funds by focusing on national transportation goals, increasing the accountability and transparency of the Federal highway programs, and improving transportation investment decision-making through performance-based planning and programming. MAP-21 has established "national performance goals for Federal highway programs:

- Safety—Achieve a significant reduction in traffic fatalities and serious injuries on all public roads.
- Infrastructure condition—Maintain the highway infrastructure asset system in a state of good repair.
- Congestion reduction—Achieve a significant reduction in congestion on the NHS.
- System reliability—Improve the efficiency of the surface transportation system.
- Freight movement and economic vitality—Improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development.
- Environmental sustainability—Enhance the performance of the transportation system while protecting and enhancing the natural environment.
- Reduced project delivery delays—Reduce project costs and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices." (MAP-21, 2012)

At the state level, agencies will invest resources in projects to achieve individual targets that collectively will make progress toward national performance goals. The goals for performance specifications in a rapid renewal context (e.g. accelerated construction, minimize user impacts, and long-lasting facilities) generally align with these strategic goals. If an agency already has a performance management initiative underway, performance specifications could be used to help translate an agency's broad policy goals and objectives down to the project level and to help instill organization-wide respect for measuring, testing, and evaluating performance. Furthermore, there may already be some individuals within the organization that understand performance metrics and how they can be best applied and implemented.

If project-level performance parameters are aligned with overarching agency goals and performance measures (e.g., safety, congestion relief), results of a particular project(s) can provide a quick gauge of the organization's overall progress towards meeting its strategic performance objectives. The on-going process of developing and monitoring performance requirements on a construction project can help accustom personnel to the broader objective of improving agency-wide performance.

Although not specifically addressed in these guidelines, performance specifications can also serve as a worthy adjunct to other management philosophies, such as lean construction. Consistent with lean principles, performance specifications aim to:

- Eliminate unnecessary and non-value-added requirements,
- Result in continuous improvement,
- Align parties around the needs of the end user, and
- Place risk on the party best able to manage it.

1.4 Rationale for Using Performance Specifications

While the motivation for using performance specifications will likely vary from agency to agency and from project to project, the literature and input from practitioners suggests that implementing performance specifications has the potential to improve quality and long-term durability. From this perspective, performance specifications better align design requirements with construction, by focusing on characteristics that more directly relate to performance and promoting an improved understanding of performance by all parties. This improved understanding of performance has further promoted the development and use of rational performance-based payment systems, replacing pass-fail or judgment calls. By being less prescriptive, performance specifications also encourage industry to innovate and take greater responsibility for performance outcomes whether it be improving quality, accelerating construction, or minimizing user impacts. Lastly, performance specifications can significantly reduce an owner's quality assurance

Primary Objectives for Using Performance Specifications

- ✓ Transfer performance risk to the contractor
- ✓ Motivate contractors to be more quality-conscious
- ✓ Improve long-term durability
- ✓ Accelerate construction
- ✓ Encourage innovation
- ✓ Reduce agency-inspection costs during construction

burden during construction (particularly if the contractor has post-construction responsibilities).

Such objectives (whether set internally by the agency or externally, as in a legislative mandate) will influence both the development and use of performance specifications. Understanding the basic rationale for using performance specifications is therefore an important first step towards ensuring a successful implementation. Once identified, these objectives must be prioritized and then communicated, understood, and accepted by all parties involved, which, in addition to agency personnel, may include the public, legislators, industry, and sureties. It is also important that the goals be understood and communicated at all levels within the agency and its industry partners, from top management down to field staff and subcontractors and suppliers.

1.5 Advantages and Disadvantages of Method and Performance Specifications

Although the guidance presented herein is intended to assist agencies with the implementation of performance specifications across a wide range of work and projects, this manual is not suggesting that method specifications and an agency's standard processes be abandoned in their entirety. Such a move would not only be disruptive to internal and external stakeholders, but could also lead to increased costs and reduced efficiency if performance specifications are not selectively applied to the appropriate projects.

As summarized in Tables 1.1 and 1.2, both method and performance specifications hold unique advantages and disadvantages that should be carefully weighed when considering how best to specify requirements for a particular project or project element. Additional details regarding the project scoping issues and key project characteristics that can influence the decision of whether performance specifications are an appropriate fit for a given project are provided in Chapter 5.

Table 1.1: Advantages and Disadvantages of Method Specifications

Advantages	*Disadvantages*
• Method specifications are well-established, easily understood, and applicable to a wide range of topic areas. • Agency can exert significant control over the work (however, this may come at the expense of increased agency inspection efforts). • Requirements are based on materials and methods that have worked in the past, minimizing risk associated with newer or less proven methods or varying contractor performance.	• The contractor has little opportunity to deviate from the specifications, and, provided that the specifications are met, is not responsible for performance deficiencies of the end product (i.e., the agency retains performance risk). • Method specifications lack built-in incentives for contractors to provide enhanced performance (e.g., cost, time, quality, etc.). • The prescribed procedures may prevent or discourage the contractor from using the most cost-effective or innovative procedures and equipment to perform the work. • Contractor payment is not tied to the performance or quality of the work. • Acceptance decisions based on test results of individual field samples can increase the potential for disputes.

Reference: FHWA Technical Advisory, Development and Review of Specifications, March 24, 2010

Table 1.2: Advantages and Disadvantages of Performance Specifications

Advantages	*Disadvantages*
• Performance specifications promote contractor innovation. • The contractor assumes more performance risk. • Contractors have the flexibility to select materials, techniques, and procedures to improve the quality or economy, or both, of the end product. • A performance specification can provide a more rational mechanism for adjusting payment based on the quality or performance of the as-constructed facility.	• The agency can exert less control over the work. • Opportunities for smaller, local construction firms may be reduced. • It can be challenging to identify all of the parameters critical to performance and establish related thresholds. • Roles and responsibilities of the contractor and agency can become blurred if not adequately defined in the specifications or contract documents. • Staff may be reluctant to assume new responsibilities.

Reference: FHWA Technical Advisory, Development and Review of Specifications, March 24, 2010

1.6 Overview and Organization of Manual

Despite the potential advantages offered by performance specifications, they will not emerge as a viable alternative to traditional method specifications overnight. For agency personnel, developing and implementing a scope of work in terms of user needs and end-result performance is often much more challenging and resource-intensive than simply adhering to the agency's standard specifications. For contractors, an initial investment may be needed to acquire the necessary knowledge, skills, and equipment to assume more responsibility for performance.

A concerted effort is therefore required on the part of senior leadership to foster a culture in which performance specifications will be embraced. To help agencies plan an effective strategy to achieve this goal, the following guidance document has been prepared to address the various cultural, organizational, and legal considerations that can affect the successful implementation of performance specifications.

1.6.1 Chapter Contents

Chapter 2 first traces how the decision to use performance specifications could affect traditional project development and delivery processes. Recognizing that such changes could have a significant effect on an agency's workforce, Chapter 2 then proceeds to provide senior managers with a roadmap for successfully introducing performance specifications to their organization in a manner that will minimize staff resistance to change.

In addition to obtaining buy-in from internal staff members, it is also important for agencies to engage local industry, as performance specifications tend to yield the best results when agency and industry personnel work in partnership to achieve project goals. To help gain industry support, agencies should first recognize and appreciate the unique challenges that performance specifications pose to contractors. The most critical of these issues, including bonding concerns and flow-down of performance provisions to subcontractors, are discussed in Chapter 3.

Chapter 4 identifies various legal precedents of which agencies should be aware to help ensure that their actions do not unintentionally compromise the enforceability of performance specifications.

Although performance specifications have been applied to a wide range of transportation projects, experience has indicated that certain conditions are more likely to yield favorable outcomes than others. Chapter 5 presents a selection process that project managers may use to assess whether performance specifying represents a viable option for a particular project or program.

In addition to the project scoping issues discussed in Chapter 5, the selected contract delivery method and procurement approach can also influence the decision of whether performance specifications are an appropriate fit for a given project. Chapter 6 presents various alternatives to the traditional process that can be used to help advance any project goals defined in performance specifications.

1.6.2 Companion Documents

An equally important component of an overall implementation strategy – specification development – is addressed in detail in Volume II of these Guidelines. Readers are encouraged to review this companion document for further information on how performance specifications can be developed and tailored to help achieve project goals.

In addition, a series of guide performance specifications developed under SHRP 2 Project R07 are available to further assist agencies with the development of project-specific performance specifications. Given the difficulty in anticipating every project need, the guide specifications are limited to the following application areas that demonstrated the greatest potential for performance specifying:

- Portland cement concrete (PCC) pavement
- Asphalt pavement
- Concrete bridge deck
- Earthworks construction and other geotechnical features
- Work zone traffic management

CHAPTER 2

Organizational Considerations

2.1 HOW PERFORMANCE SPECIFICATIONS AFFECT PROJECT DEVELOPMENT PHASES

Early Project Development
Design Phase
Construction Quality Management
Post-Construction Performance Monitoring (for warranties and DBOM agreements)

2.2 FOSTERING A PERFORMANCE-BASED CULTURE

Establish the Need
Develop and Communicate a Vision for Using Performance Specifications
Form the Right Team
Empower Others to Act on the Vision
Develop an Action Plan and Include Milestones for Short-term Achievements
Institutionalize Performance Contracting

Chapter Objectives

This chapter addresses the following questions:

- How will the decision to use performance specifications affect traditional project development phases?
- How can agencies help foster a culture in which performance specifications will be embraced by both internal staff members and industry?

2. Organizational Considerations

Unless an agency actively uses alternative project delivery methods such as design-build, its policies, procedures, and organizational structure will likely bear the imprint of years of near-exclusive use of method specifications implemented under the traditional design-bid-build delivery system. Over the years, this approach has provided taxpayers with an adequate, safe, and efficient transportation facility at the lowest initial price that responsible, competitive bidders can offer. Accordingly, most agencies have structured their staff in a manner that will most effectively and efficiently support the needs of this system. Distinct departments have been created to nurture skills and transfer and preserve knowledge in specific functional areas such as design, materials, construction, and maintenance. Standards and manuals have been developed to promote consistency and facilitate the immersion of new or less experienced employees into the organization. Standard specifications and standard details allow much of the engineering and design work to be performed by junior staff, just as materials and construction manuals allow less experienced inspectors to adequately assume quality assurance functions during construction.

Much of the institutional knowledge that allows the traditional system to flourish will not directly transfer to the implementation of performance specifications. As described further in Section 2.1 below, performance specifications require different skills, processes, and management and coordination efforts for implementation to be successful. To fully integrate performance specifications into an agency's toolbox will therefore require the development of a new organizational context that imposes new roles, responsibilities, and relationships.

For such changes to take root, a concerted effort must be made to achieve staff buy-in that a performance specifications initiative is worth pursuing. Absent such buy-in, personnel may never truly commit to putting a performance specification strategy into action, and the implementation effort will likely fall flat.

Fortunately, change management has been the topic of numerous research studies over the years, and best practices and lessons learned are covered extensively in the literature related to management and organizational psychology. Based on these proven techniques, Section 2.2 provides senior leadership with a roadmap for successfully introducing performance specifications to their organization in a manner that will minimize staff resistance to change.

2.1 How Performance Specifications Affect Project Development Phases

To appreciate the challenges (and potential benefits) associated with performance specifications, it is necessary to first understand how and why their implementation would differ from that of method specifications. The following guidance traces how the decision to use performance specifications can affect various project development phases, from project planning and preliminary engineering through to construction completion and possibly beyond to maintenance and asset management. First, however, the general process by which agencies have traditionally developed project plans and specifications is presented for comparison purposes.

Under the traditional system, an agency will generally use in-house design staff (or alternatively, will retain a consultant) to prepare 100% complete plans and specifications that fully define the contractor's scope of work and project requirements. These design documents are then used to procure contractors (typically on a low-bid basis) to build the project in strict accordance with the contract documents. The agency evaluates the bids received, awards the contract to the lowest responsible and responsive bidder and, by virtue of the method specifications, retains significant responsibility for quality, cost, and time performance.

Developing a scope of work in terms of user needs and end-result performance is often much more challenging and resource-intensive than simply adhering to the agency's standard specifications. Project staff must have the knowledge, skills, and experience to craft a realistic performance measurement system that will ensure the needs of the agency and other stakeholders will be met, without materially compromising the intended risk allocation strategy, stifling creativity and innovation, affecting value for money, or otherwise detracting from project goals. The following guidance is intended to help agencies identify where the implementation of performance specifications will likely require a departure from their standard project development process.

2.1.1 Early Project Development

Deciding to Use Performance Specifications. To incorporate performance specifications into an agency's contracting tool box requires modification of the agency's traditional project planning and scoping efforts to include an evaluation of whether or not to use performance specifications. To the extent possible, this decision should occur early enough in the project development process to ensure that design efforts are not so far advanced that a substantial "de-engineering" effort would be necessary to prepare performance specifications. While a decision as early as possible in project development will provide greater potential for industry innovation under a performance specification to realize cost or time savings, there are cases where performance specifications have also been successfully applied under a traditional contract delivery system or later in the project development process (e.g. using advanced measurement and testing methods, mechanistic properties, etc.).

As addressed in Chapter 5, many considerations factor into the decision of whether or not to use performance specifications, including the choice of project delivery method. The step-by-step selection procedure presented in Chapter 5 can facilitate the decision-making process, but it is difficult to define a cut-off score that automatically dictates or eliminates the use of performance specifications. Given specific project conditions or objectives, a single factor can override all others in determining the most appropriate choice for a specific project.

Assigning a Project Development Team. A multi-disciplined team, including representatives from design, materials, construction, and maintenance, should be assigned early on in the project development process to not only help with this selection decision, but to also provide assistance thereafter during the specification development and performance monitoring efforts.

Unlike the implementation of traditional method specifications, in which individual team members may not be active during all phases of a project's lifecycle, projects on which performance specifications are used would benefit greatly from the continued involvement of key personnel and information sharing across departmental lines.

For example, the field construction representative, who will ultimately be overseeing construction, should participate in the specification development process to ensure that construction-phase issues (e.g., the quality management process, long-term maintenance considerations of possible design alternates, maintenance and protection of traffic, etc.) are given the appropriate attention in both the specification itself and in the accompanying solicitation package (particularly if a best-value procurement process is used).

Similarly, the engineers that participate in the preliminary design work and in the preparation of the specifications and solicitation package should remain involved after contract award to oversee and review any performance monitoring results, especially if performance parameters are intended to verify key design assumptions (e.g., pavement modulus). In addition to monitoring post-construction performance, maintenance personnel should be consulted during specification development to help establish appropriate performance targets and thresholds given historical data from asset management systems.

Identifying Project Goals. Understanding user needs and communicating clear and concise project goals are critical to the success of any project. However, given the nature of performance specifications, articulation of needs and goals takes on even greater importance as they set the foundation for the entire project development process. Decisions made with respect to performance measures, risk allocation, procurement approach, and project delivery method all stem from the goals established at project inception. For example, if a project goal is to enhance innovation, the performance specifications should provide the contractor enough freedom to incorporate creative solutions, just as the selected contract delivery method and procurement approach should also help in advancing this goal to the extent possible.

Early in the project development process, the project team, with input from other key stakeholders as necessary, should therefore develop and refine a list of project goals. As it is rarely possible to optimize quality, time, and cost goals on a single project, tradeoffs may be necessary to ensure that the primary goal is achievable. Reaching a consensus on the relative importance of individual project goals will help the project team make informed decisions regarding the use of risk management and incentive strategies designed to increase the likelihood of achieving the primary project goal (e.g. enhanced quality), even if at the expense of secondary goals (e.g., cost).

2.1.2 Design Phase

Determining the Appropriate Level of Design. The level of agency design is an important consideration when implementing performance specifications. If contractor innovation is a primary goal, the agency should only perform the level of engineering and design necessary to support the environmental process, advance right-of-way acquisition, and identify the full scope, needs, and technical criteria for the project in accordance with the risks to be allocated to the contractor. In general, the agency's design effort should identify the project's needs and objectives, but not necessarily prescribe solutions.

An appropriate parallel would be the level of design required for a design-build project. Agencies experienced in design-build contracting often report higher levels of project satisfaction with lower levels of preliminary design (with 30 percent often cited as a benchmark). However, this is not to say that the same level of preliminary design should be applied to every project, or that every element within a single project should be taken to the same level of design. Each project, as well as each component of a single project, must be examined to determine the extent of preliminary or conceptual design needed to clearly convey the agency's performance expectations. For certain project elements, defining performance requirements could require close to 100 percent design, whereas for others, very little design may suffice.

Preparing Specifications and Solicitation Documents. Although it may not be necessary to prepare a 100% complete design package, the agency will have to redirect some of its previous design efforts to the development of an appropriate performance measurement strategy as described in detail in Volume II of these Guidelines. This effort will likely require dedicated resources, beyond that typically required to develop conventional specifications, to collect and analyze system-wide performance data for use in setting performance target values and thresholds.

Consideration will also have to be given to what contract documents need to accompany the performance specifications. The level of detail included in the plans and details should correspond to the flexibility extended to the contractor in the performance specifications. Inclusion or reference to an agency's standard details may therefore be inappropriate.

If a best-value or qualifications-based procurement process is contemplated, preparing the solicitation documents and evaluating the proposals received may also entail a significant effort beyond that traditionally performed by the agency. If the agency does not have the necessary expertise in-house, it may be advantageous to retain outside specialists. For example, if implementing performance specifications under some variation of a design-build-finance approach, the agency should consider seeking outside financial expertise to ensure the public's interests remain protected while negotiating with a private entity that will likely have significant experience in this area. Given the importance of the procurement step to successful implementation, Chapter 6 discusses various procurement issues and contract award considerations.

Design Quality Management. If the performance specifications are implemented under the design-build approach, agency personnel will have to assume new design oversight responsibilities to ensure that the contractor's design meets the intent of the contract documents. The agency's oversight activities will generally include monitoring and auditing design progress, and verifying compliance with contract requirements.

In reviewing design submittals, agency staff should be careful about recommending solutions to design problems. Any suggestions offered should be made with the express provision that the contractor is not required to accept the suggestion. Requiring otherwise may result in the agency unintentionally assuming liability for aspects of the design that should remain with the contractor. Section 4.2.2 addresses the issue of owner interference in greater detail in the context of relevant case law.

To foster a collaborative project development process, the agency may wish to consider co-locating its key personnel with those of the contractor. Co-location is intended to facilitate regular interaction and the free exchange of information between the parties in a manner that will help accommodate the fast-paced nature of design-build and rapid renewal.

2.1.3 Construction Quality Management

Managing quality has traditionally been an agency responsibility. However, performance specifications provide the opportunity to expand the contractor's role in construction quality management beyond conventional process control activities to include several of the quality assurance tasks traditionally performed by agency personnel. Although this approach may represent a departure from the traditional manner in which agencies allocate responsibility for quality management, it is consistent with the degree of risk assumed by the contractor for performance of the work. Too much oversight by agency personnel could shift significant risk back to the agency, as well as add time and inefficiency to the project in contradiction to the goals of rapid renewal; too little could compromise safety and performance.

With the contractor assuming a larger role for quality management under a performance specification, agency inspectors will transition from performing continuous on-site inspections as to the quality, performance, and quantity of the work to assuming more of a verification role that involves performing such duties as:

- Spot-checking construction for compliance with design plans and project specifications;
- Evaluating construction at any "witness and hold" points stipulated in the contract;
- Verifying that members of the contractor's quality management staff:
    - Have proper qualifications
    - Are present to observe and control the work
    - Are carrying out the contractor's quality management plan
- Performing verification sampling and testing of the contractor's test data for acceptance purposes;
- Determining if acceptance should be at full or adjusted payment;
- Verifying progress and reviewing payment requests;
- Auditing safety records;
- Auditing environmental compliance records; and
- Conducting and managing the review of as-built plans.

Although the contractor may assume a larger role for testing and inspection under a performance specification, responsibility for *acceptance* will continue to reside with the agency. If contractor test data will be used in the agency's acceptance decision, the agency, or its designated agent (i.e., consultant under direct contract with the *agency*), must perform some level of independent verification sampling and testing to meet the intent of Title 23, Code of Federal Regulations, Part 637. Use of a third-party testing and inspection firm hired by the contractor does not relieve the agency of its responsibility for verification. Likewise, splits of contractor-obtained samples cannot be used for verification purposes.

Similarly, even if the performance specification includes post-construction requirements that will effectively postpone *final* acceptance until the end of a warranty or maintenance term, the agency should still address *initial* acceptance at the end-of-construction to ensure that the contractor completed the basic scope of the work in accordance with the contract documents.

Best Practice in Construction QA: Michigan's Construction Quality Partnership

In 2004, the Michigan transportation construction industry, in partnership with Michigan Department of Transportation (MDOT), Federal Highway Administration, County Road Association of Michigan and Michigan Municipal League, initiated the Construction Quality Partnership (QCP) – a comprehensive plan to improve quality by training and certifying all individuals, agencies, and companies who are involved in the design and construction of the transportation system in Michigan.

The initiative entails a joint training and certification program for both owner/agency and contractor personnel. Training is targeted to three organizational levels:

- Strategic – for corporate/executive management
- Technical – for project engineers/managers
- Hands On – for labor/inspection personnel

The side-by-side nature of the training allows agency and industry personnel to gain appreciation for the contribution each entity makes to assuring quality, facilitating subsequent interactions on the job.

The goal of the program is to change the way agency and industry personnel think about quality by expanding it beyond traditional materials testing. Construction practices must reflect the fact that operations, such as mixing and placing materials, have as great an effect on performance as does the quality of the individual materials. Through state-of-the-art personnel training in the areas of project development, construction processes, inspection, and equipment operation, the CPC aims to instill a focus on quality and continuous improvement in all individuals involved on transportation construction projects.

Once the training program is fully implemented, the plan is to develop corporate certification criteria that would require contractors and consultants seeking work on MDOT projects to establish a corporate quality program.

The ultimate vision for the CQP is to include a post-construction review process that will provide a feedback loop to support continuous improvement efforts.

With time and commitment of agency and industry leaders, the Michigan CQP initiative can be replicated in other locations to ensure that personnel are properly trained and equipped to delivery projects of the highest quality.

2.1.4 Post-Construction Performance Monitoring (for warranties and DBOM agreements)

Implementing performance specifications that assign post-construction responsibility to the contractor (for example, through warranties or maintenance agreements) does not diminish the agency's responsibility to the public to provide a highway facility that performs to the desired level of service.

Even if such agreements were to transfer all maintenance and repair activities to the contractor, agency personnel would still have to assume management and administrative duties to monitor and verify contractor performance during the operation and maintenance period. Depending upon the length of the post-construction period and the project goals, agency responsibilities may entail:

- Auditing and review of documentation, reports, self-appraisals, and performance data submitted by the contractor.
- Performance monitoring to ensure the facility continues to meet the specified performance requirements. Depending on the length of the post-construction period, this could require a number of formal condition surveys (ideally conducted using high-speed methods comparable to the agency's standard network-level asset management system), as well as more informal "windshield" surveys.
- Analysis and interpretation of performance data.
- Assessment of pay deductions (or penalty points) if the facility fails to meet performance standards and the contractor does not respond with the appropriate remedial action within the prescribed timeframe (primarily for long-term maintenance agreements).
- Issuance of work permits and assessment of lane rental fees when the contractor needs to take lanes out of service to perform maintenance or repair work.
- Handback inspections prior to the end of the contract term (particularly for long-term operations and maintenance agreements).
- Final acceptance and project closeout activities at the end of the warranty or maintenance term.

Given the administrative burden that accompanies these responsibilities, it would be advisable for interested agencies to develop a performance monitoring plan and dedicate staff resources at the program level prior to applying post-construction performance agreements on a widespread basis. A comprehensive monitoring program is essential to ensuring all performance objectives are continually met. For example, a computer-automated system to alert contract managers of the need to perform a monitoring event would alleviate some of the onus placed upon individual contract managers to recall the timing of inspection events or other contract triggers, particularly if the duration of the contractor's post-construction responsibilities extends several years and could overlap with turnover in agency staff assignments. The implementation plan should also address which department (e.g., Construction, Materials, Contract Administration, Maintenance, Innovative Delivery, etc.) would have primary responsibility for such post-construction oversight and monitoring duties. Most likely, additional management and coordination across departments and field divisions would be required to verify and manage contractor compliance throughout the full contract period. To help streamline the collection and analysis of performance data, the agency should consider initially applying the same approach (e.g., similar performance parameters and data collection methods) as used under its standard asset management system.

2.2 Fostering a Performance-Based Culture

The most critical element of implementing anything new – performance specifications included – is the ability to manage the change within the organization to ensure that personnel understand both the need for the change and the benefits it will provide.

As discussed above, successful implementation of performance specifications will likely require a departure from traditional project development and delivery processes. To foster a culture in which such changes will be embraced requires, as a minimum, acknowledgement from senior management that performance specifications could have a significant effect on the agency's workforce.

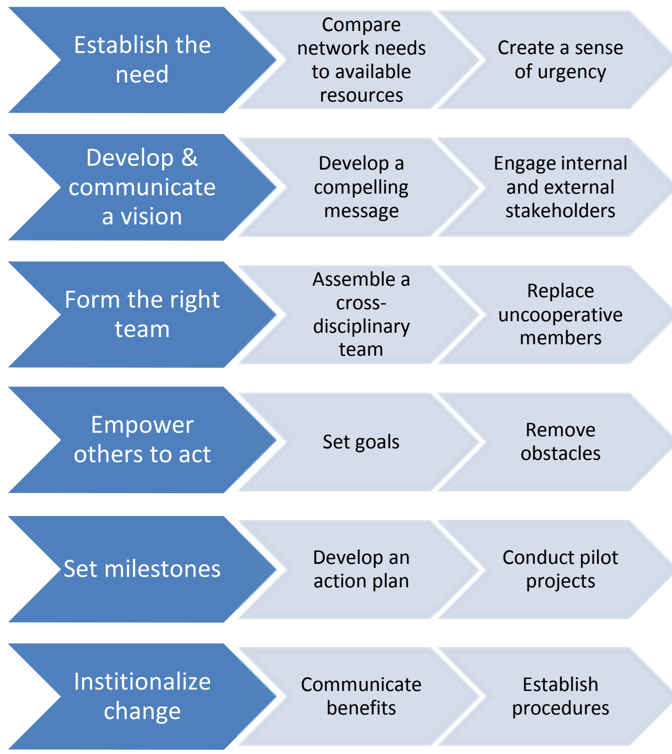

Figure 2.1: Gaining Support for Performance Specifications

Figure 2.1 adapts the process presented in John Kotter's seminal work on change management, *Leading Change*, to the steps needed to integrate performance specifications into an agency's standard operating procedures (Kotter 1996). The actions needed to progress through each step are summarized in Table 2.1, as are the potential pitfalls that could hinder the initiative. While designed as a sequential process, clearly there can be flexibility in how it is implemented. The first and last steps, "Establish the need' and "Institutionalize change" would not change, but interim steps (i.e. "Communicate vision" and "Form the team") might be accomplished concurrently or in a different order). Each of these steps is further described in the narrative that follows.

Table 2.1: Necessary Actions and Potential Pitfalls in Implementing Performance Specifications

Step	*Actions*	*Potential Pitfalls*
Establish the need	• Compare network needs to available resources to determine if performance specifications would provide a better means of achieving organizational goals than traditional method specifications • Continually champion the development and use of performance specifications for appropriate projects	• Lack of Executive involvement
Develop and communicate a vision for using performance specifications	• Engage internal and external stakeholders with a compelling message as to why performance specifications would be a valued addition to an agency's contracting "toolbox"	• Lack of a simple and concise vision as to how performance specifications can help fulfill an agency need(s) • Inability to communicate the vision • Failure to achieve industry buy-in • Behaving in ways contrary to the vision (e.g., using performance specifications indiscriminately, not allowing industry sufficient flexibility, etc.)
Form the right team	• Assemble a cross-disciplinary team that is willing to modify the agency's traditional processes to accommodate the use of performance specifications	• Failure to get past traditional silos of responsibility (e.g., between design and construction; pavement and geotech, etc.) • Failure to tap the right people to develop and implement performance specifications
Empower others to act on the vision	• Remove obstacles that would undermine efforts to implement performance specifications • Recognize that traditional project development phases may require modifications to realize the benefits of performance specifications	• Failure of senior leadership to remain involved in the performance specification initiative and to remove obstacles to their successful implementation • Underestimating how the use of performance specifications can affect an agency's workforce and standard project delivery processes • Underestimating organizational inertia and the difficulty of pushing people out of their comfort zones

Step	*Actions*	*Potential Pitfalls*
Develop an action plan and include milestones for short-term achievements	• Identify goals and objectives of the implementation effort • Conduct trial projects or demonstrations	• Failure to set realistic expectations • Failure to adequately account for the learning curve that people (both internal staff and industry) must navigate before understanding and mastering a new process or technology
Institutionalize performance contracting	• Identify and communicate benefits of using performance specifications • Add performance specifications to the agency's contracting "toolbox"	• Failure to formalize new procedures • Lack of patience related to realizing the benefits of performance specifications

2.2.1 Establish the Need

Strong endorsement from upper management can help garner broad employee support for the changes needed to fully deploy performance specifications on a programmatic level.

To gain such support, best practice suggests first establishing the specific rationale as to why performance specifications represent a necessary addition to an agency's contracting toolbox. For example, the literature suggests that implementing performance specifications has the potential to improve quality and long-term durability, encourage innovation, accelerate construction, and reduce an owner's quality assurance burden during construction (particularly if the contractor has post-construction responsibilities). If a comparison of network needs to available resources suggests that performance specifications would provide a better means of achieving an agency's strategic goals than traditional method specifications, a greater sense of urgency can be created regarding the implementation effort.

Without such an underlying basis for change, people may not be as inclined to alter their habits to implement what they may otherwise perceive to be an executive whim to experiment with new processes. Creating a sense of urgency regarding why a change initiative provides the right solution for a particular problem tends to be more motivating than simply issuing a top-down command.

Establishing a Sense of Need: UK Highways Agency

Today, the UK Highways Agency is a leader in the use of performance specifications and alternative contracting strategies that place more responsibility for quality and performance on industry.

This development was largely in response to a series of targeted government initiatives aimed at addressing perceived problems with the UK's construction industry as a whole. In the mid-1990s, government leaders, encouraged by productivity gains achieved in the manufacturing industry through the introduction of lean production techniques, sought ways to attain similar results in the construction industry.

At the time, the construction industry was largely viewed as under-performing with respect to customer satisfaction, capital investment, research and development, training, and commitment to safety and quality, failings that often led to adversarial relationships with owners, cost overruns, and extended project durations.

In order to identify how to best fix these problems and modernize its construction industry, the UK first focused on identifying what was broken. Key findings from early government-sponsored research included the following (Egan 1998, 2001):

- The rate of profitability in construction was too low and unreliable to induce contractors to make sustainable investments in capital improvements, research and development, and training, often at the expense of quality and innovation.
- Owners equated price with cost, and did not differentiate between best value and lowest price. Furthermore, competing all work, instead of creating longer-term relationships with industry partners, inhibited learning, innovation, and development of skilled and experienced teams.
- Too many independent construction firms and subcontractors had fragmented the industry, hindering team continuity and performance improvement.
- Contractors had no stake in the long-term success of the project and were not accountable to the end-user. Instead, contractors were always focusing on the next client and the next job.

Recommended solutions to address these perceived deficiencies included:

- Creating a culture of partnership, both between owners and contractors, and between designers, subcontractors and the supply chain, to enable the team to learn and make incremental improvements over time that would improve long-term efficiency.
- Focusing on the end-products and the needs of the end-user.
- Setting targets for performance and continual improvement.
- Selecting partners based on the best value, not the lowest price.

Such findings and recommendations established the foundation by which the UK planned to improve the quality and efficiency of its construction industry. The HA, which by the late 1990s was already outsourcing a significant portion of its design, construction, and maintenance work (albeit to separate entities), was receptive to these recommendations and began to develop contracting vehicles that could support these goals. Although these contracts have evolved over the years, the basic tenets have remained the same – long-term partnerships with service providers, use of performance specifications, best-value procurement processes, performance benchmarking, and expectations of continual improvement.

It should be noted that successful implementation of these new contract forms did not take place overnight. Ingrained allegiance to the traditional competitive low-bid procurement process initially impeded efforts to change the status quo. However, through the wholesale adoption of performance contracting principles the HA was able to effectively communicate to its own personnel and to industry that adapting to the new business model was necessary for continued success.

2.2.2 Develop and Communicate a Vision for Using Performance Specifications

People are generally reluctant to alter their habits. In absence of a compelling reason to change, staff will continue to do what they've always done and will strive to retain the processes that are familiar to them. Once the need for performance specifications is established, it is important to communicate this need through a clear and concise vision statement.

The vision statement should serve to both motivate individuals and ensure everyone is working towards a common goal. For example, an agency with minimal resources to devote to construction inspection may wish to communicate that performance specifications will allow the agency to do more with less by empowering industry to assume more responsibility for quality and performance. Similarly, agencies that are more interested in innovation may wish to focus on the idea of capitalizing on the expertise of the private sector.

Achieving buy-in from industry is also critical to the successful implementation of performance specifications. Although performance specifications impose greater risk on contractors, they also offer the opportunity for increased profit margins should contractor-initiated design, process, or technology innovations yield improved efficiencies or cost savings. This may require a tailored message that focuses on the benefits performance specifications would bring to industry, while also offering assurances that opportunities for smaller or local firms would not disappear.

2.2.3 Form the Right Team

As addressed in Section 2.1.1 above, assembling a multi-disciplined team of individuals, who are willing to move past traditional silos of responsibility, is a key element of a successful implementation strategy. One approach used by several agencies is to set up a special projects group (or alternative delivery office) to develop staff experience and provide leadership and support related to non-traditional contracting practices. Training and continued support from senior managers can also help reinforce any changes in traditional roles and responsibilities and standard operating procedures needed to accommodate performance specifications.

2.2.4 Empower Others to Act on the Vision

Once a vision for performance specifications has been communicated and a team has been established to act on this vision, senior managers should remain engaged to ensure that the initiative moves ahead with minimal obstacles. If management does not remain actively involved, it can be difficult to determine if the chosen team has the necessary knowledge, skills, and resources to implement performance specifications as intended.

As addressed in Section 2.1 above, it may be necessary to modify traditional processes to realize the benefits of performance specifications. Likewise, organizational structure can also present barriers to successful implementation of performance specifications. Narrow divisions of work can reinforce traditional silos and undermine efforts to develop comprehensive performance specifications that have the road user in mind.

Another obstacle may be related to equipment and technology. Advances in non-destructive testing techniques may ultimately allow agencies to incorporate acceptance parameters that better reflect the future performance and design life of the facility. Although a lack of appropriate equipment may represent a gap in a performance measurement strategy, new technologies are often difficult to absorb into daily practice. To ensure an adequate return on investment, agencies should develop an implementation and roll-out plan to shepherd new technology into routine use. Depending on the technology, this may require new IT infrastructure to manage large quantities of electronic data and a learning curve before the full potential of the new technology can be realized.

2.2.5 Develop an Action Plan and Include Milestones for Short-term Achievements

To avoid discouragement, it is also important to acknowledge that successful implementation of performance specifications will not occur overnight. Agencies may have to devote considerable time and resources to collect the historical data needed to establish reasonable performance targets and tolerances. Investment in new technologies and information systems may also be necessary to support all of the performance parameters that the agency wishes to implement.

Likewise, it is also important to appreciate the impact that performance specifications will have on industry. Agencies should collaborate with industry during the specification development process and encourage contractors to invest in state-of-the-art equipment and construction process control. Quite often an initial investment is required by contractors to acquire the necessary knowledge, skills, and equipment to assume more responsibility for performance. One way to ease this transition is to gradually phase in the use of performance specifications over time, starting with demonstrations and pilot projects before expanding to a more widespread programmatic level.

It may also take time for benefits of performance specifying to become transparent. Initially, the agency may receive higher bid pricing due to contractor uncertainty regarding the risks involved. As industry grows more familiar with performance specifications and comfortable with their ability to manage the risks, some contractors may actually see a competitive advantage to using performance specifications that is passed onto the agency in the form of lower bid pricing.

2.2.6 Institutionalize Performance Contracting

As with any new process, internal and external stakeholders must be educated as to the potential benefits of performance specifications. A powerful way to communicate this message is through the successes and lessons-learned from demonstration projects. In relating this information, it is important to make a conscious attempt to convey exactly how the use of the new specifications helped to improve performance. If people are left to draw their own conclusions, they may not make the right associations. For example, people could associate a project's success to the fact that it was performed by a contractor's "A" team working together with the agency's most seasoned resident engineer, and not to the project's performance specifications that helped promote innovation and quality-conscious behavior.

Project successes and lessons-learned should then be translated into formal procedures that provide agency-specific guidance related to the development and implementation of performance specifications.

Chapter 3

Industry Considerations

3.1 Managing Subcontractor Relationships Relative to Performance Requirements

Limitation of Liability
Flow-Down of Contractual Provisions
Managing Performance Specifications

3.2 Bonds, Guarantees, and Other Mechanisms

Unique Risks in Using Performance Specifications and Long-Term Warranties
Bond and Insurance Marketplace
Alternatives to Bonds and Insurance
Default Insurance and Efficacy Insurance
Current Practices
Recommendations for addressing risks related to long-term performance guarantees

3.3 Garnering Industry Support

Chapter Objectives

This chapter addresses the following questions:

- What challenges and risks do performance specifications pose to prime contractors?
- What concerns does the surety industry have regarding long-term bonds?
- What are the alternatives to traditional performance or warranty bonds?
- What can be done to garner industry support for performance specifications?

3. Industry Considerations

The preceding chapter primarily focused on the implementation of performance specifications from the agency's perspective. However, performance specifications, particularly those including warranties or other post-construction responsibilities, will also present unique risks and challenges to the construction industry. Gaining industry support to take on new roles and responsibilities is crucial to the success of implementing performance specifications. Quite often the industry's risk appetite determines the success of implementation. Contractors and sureties with limited experience will decline to compete or price the risk into their bids. With the introduction of new specifications or contracting methods that shift responsibility to industry, successful implementation often requires a gradual or stepped process for industry to gain the required skills and experience. Two important issues contractors must consider from a risk perspective include managing subcontractor/supplier relationships and meeting bonding requirements, as discussed below.

3.1 Managing Subcontractor Relationships Relative to Performance Requirements

Subcontractors and suppliers play a major role in the successful implementation of performance requirements. Prime construction contractors assume the contractual responsibility for meeting performance guarantees. However, the parties who typically have the skills to achieve these guarantees are specialty subcontractors and suppliers. They may have proprietary technology or products that allow this to take place, or they may have built their businesses to become "centers of expertise" in a given area of performance. As discussed below, this can create several pragmatic challenges in how to "flow down" contractual performance requirements to subcontractors and suppliers.

3.1.1 Limitation of Liability

Perhaps the biggest challenge is that suppliers of technology or products are not willing to take major commercial risks that could result in liability far in excess of their contract price. Suppliers will commonly condition their willingness to furnish goods or technology on a particular project to an agreement by the prime contractor that the supplier will have a contractual limitation of liability (frequently capped at 100% of their contract price) for any deficiency attributable to the supplier. As discussed below, these conditions can create potential "gaps" in liability, which can create problems in obtaining recourse for a performance failure.

On industrial projects such as power and petrochemical plants, limitations of liability are an accepted part of the contracting landscape between owners and contractors. However, the public sector has not widely adopted limitations of liability for prime contractors – other than on a handful of mega-projects where limitations of liability were required to obtain adequate price competition. Therefore, on rapid highway renewal projects, a prime contractor will likely be required to assume the risk of the "gap" between the limitation of liability it gives to a supplier and the liability that is incurred if the supplier fails to meet the performance guarantee. This "gap" risk is exacerbated because of the large difference in the contract price of a purchase order vis-à-vis a prime construction contract.

In theory, there is justification for a trade subcontractor requiring an overall contractual limitation of liability. To date, however, most subcontractors have not made overall liability caps part of their contracting philosophies. But subcontractors are nevertheless very sensitive to how much liability they are willing to incur for delay damages, or other discrete damages, associated with their performance on a given project. They pay particular attention to delay-related liquidated damages amounts in the prime contract, and they generally expect to negotiate a lower value for liquidated damages exposure than the prime contractor has assumed in its contract with the owner. This is especially important for large projects where the liquidated damages may be a large daily value.

3.1.2 Flow-Down of Contractual Provisions

Another challenge experienced by prime contractors in obtaining subcontractor/supplier compliance with performance specifications is the flow-down of contracting terms. Prime contractors often handle flow-down responsibilities with simple language saying, in effect, "subcontractor is bound to provide to the contractor whatever the contractor is obligated to provide to the owner." A performance specification can be so simple as to require only one trade to accomplish it. However, it is far more typical that a number of players (including both designers and trade contractors) will be required to coordinate to achieve the performance specification. This raises issues as to:

- who is truly contractually responsible to meet the specifications;
- how the coordination efforts will take place to ensure compliance; and
- how much leeway does one party have in its performance when it could affect another's performance.

Consider, for example, the tolerances that apply to each party's work. If a performance specification is tied into steel and concrete operations, are normal industry tolerances going to be sufficient to achieve the specification, or is there a need to have one of the trades subject to tighter tolerances than expected? Using simple "flow-down" language does not allow these issues to be carefully thought through and considered, creating a gap in responsibility.

Incentives and Disincentives. A reciprocal issue is how to handle incentives and disincentives when they relate to subcontractors and supplier performance. The prime contractor will frequently simply flow down verbatim whatever is in its prime contract – subject, of course, to the issue of limitations of liability discussed earlier. This approach does not work well when achievement of the performance requirement can only occur through the cooperation of a number of players. The better practice is to have a meaningful discussion with the party that is best capable of achieving the performance requirement about what can be done to ensure that it can be accomplished, and then recognizing an appropriate contracting method for achieving this result.

Warranties. Another challenge relates to how to handle warranties on performance specifications that flow from subcontractors and suppliers. Depending on the length of the warranty, and the type of performance specification, it can be administratively confusing for the owner and prime contractor as to how to access the subcontractor/supplier. There are two common best practices to address this. One is to have these warranties specifically discussed with the subcontractor and supplier, and determine how these will be administered after construction completion. The second is to give the owner the contractual right to deal directly with the subcontractor/supplier after construction completion, during the warranty period, through an assignment of the warranty provision in the prime contract and the relevant subcontracts.

3.1.3 Managing Performance Specifications

The final major challenge relates to how prime contractors manage the process of evaluating and achieving performance specifications. Those who think carefully about the process, and identify which of their subcontractors and suppliers are vital to achieving the specification, generally do well. They will have coordination meetings and develop specific contractual language and execution plans with this interdisciplinary process in mind. On the other hand, those who treat the specification trivially, leaving the subcontractors and suppliers to figure out compliance and coordination, will often find themselves struggling to determine how to meet their contractual requirements to the owner, without likely having any recourse to go back to the subcontractor or supplier.

3.2 Bonds, Guarantees, and Other Mechanisms

Agencies have faced challenges finding bonds and other forms of guarantees to support programs that use a combination of performance specifications and warranties. Typically, agencies have required a warranty bond to guarantee that contractors will perform their warranty obligations during the warranty period. These bonds are secured through a surety, which guarantees that if the contractor fails to perform during the warranty term, it will be responsible for the cost of remedial work to the limits of the warranty bond. How the bond limits are determined varies from agency to agency, and the methodology may vary based on the component being warranted. For example, the bond values may be by:

- Total dollar value of the warranted work (i.e., full value of the contractor's contract)
- A percentage of the total dollar value
- The lower value between a percentage of the contract value and a set dollar amount (i.e., 5% or $2,000,000)
- Estimated cost to perform a repair

Contractors, however, have found it difficult to obtain such bonds or other suitable guarantees of performance for long-term obligations. Although there is little published research on this issue, a combination of information from the existing literature and information from subject matter experts in the surety and insurance industry supports the conclusion that this challenge stems from two primary factors:

- **Unique risks in using performance specifications:** Performance specifications on highway projects present unique risks to the industry, regardless of the scope or duration of the contractor's performance responsibilities. Depending on the way the contract is structured, these risks have the effect of limiting the pool of contractors who are willing or capable of entering into contracts with the agency. These risks also have a pragmatic impact on the willingness of an entity, such as a contractor, manufacturer, or corporate parent, to provide financial security that backstops the contractor's obligations.

- **Bond and insurance marketplace:** The surety and insurance marketplace currently has a limited appetite to provide security vehicles supporting the long-term performance obligations desired by agencies, particularly when those vehicles are tied to the performance of assets over their design life. The surety market has historically been unwilling to underwrite long-term exposure unless the contractor is large and well-capitalized. Moreover, entities who have created alternatives to performance and warranty bonds, such as subcontractor default insurance, have been unwilling as of yet to expand their product lines to cover long-term warranties based on performance specifications.

Before addressing some of the potential mechanisms that agencies may use to support long-term warranties and performance specifications, these two issues are discussed further below.

3.2.1 Unique Risks in Using Performance Specifications and Long-Term Warranties

Regardless of whether the contractor's performance obligations are secured through a bond, corporate guarantee, letter of credit, or some other financial instrument, the first question to consider is the nature of the risk associated with providing such financial backstop. The factors used to assess the risks of performance specifications and long-term warranties include a determination by the contractor, and those providing financial backstops, of the following:

- the ability to achieve the performance standards by objective means and measurable standards;
- impact on performance by factors outside their control;
- an objective historical baseline to assess the ability to meet the performance standards;
- expectations and criteria clearly set forth by the agency in the contract;
- the ability to demonstrate and validate the efficacy of the contractor's work, years after the work is performed; and
- the balance between risk-reward opportunities.

The risks associated with performance specifications can heavily influence the ability of a contractor to provide a suitable guarantee of its performance, particularly when the guaranty is providing financial support for a long-term warranty. The primary risk areas are as follows:

- **Measurement technology and sampling:** The inability to ensure that the contractor's performance can be precisely tested, measured and sampled – either because technology does not allow it, or because the agency has yet to implement available technology – means that the contractor and its guarantors face the uncertainty of meeting the agency's expectations. A related concern is whether the samples taken will be consistent and representative of overall performance.

- **Factors outside of industry control affecting long-term performance:** The inability of the contractor to predict or control how the facility will perform or be used can have a significant impact on long-term warranties. For example, if the warranty does not have exclusions for pre-existing conditions (e.g. pavement base, drainage systems), extreme events, inaccurate traffic predictions, or inadequate design by others, the contractor and its guarantors will be reluctant to provide suitable long-term guarantees.

- **Combination of performance and prescriptive specifications:** When performance and prescriptive requirements are combined, contractors are in effect being expected to provide guarantees that the constructed facility will perform as expected when they have not fully controlled the design. This lack of control impacts appetite for risk assumption.

- **Inability of small contractors to assume risks:** As projects and programs become more complicated, particularly in terms of providing financial backstops of performance, smaller contractors may be unable to participate in any meaningful capacity, particularly if they receive resistance from their bonding companies.

- **Inability to predict performance based on engineering properties or other parameters measured at the time of production or installation:** The relationship between engineering properties and performance can be tenuous. The risk is that the predictions will not remain valid over the life of a warranty, particularly if the warranty is expected to approach a design life of multiple decades.

The combination of these risks creates a high level of uncertainty for third-parties who are in the business of providing financial support for contractor's performance obligations. This is particularly true when the overall duration of the performance obligation is extended beyond the normal construction period to assume risks for warranty or maintenance obligations.

3.2.2 Bond and Insurance Marketplace

The public sector construction industry in the United States has long relied upon performance bonds to secure the faithful performance of a contractor's obligations. Performance bonds and warranty bonds are three-party agreements in which the surety guarantees to the owner (called the "obligee") that the contractor (called the "principal") is capable of performing the contract and protecting the obligee from financial loss if the principal does not perform. Bonds are credit instruments and are underwritten in a manner similar to bank loans. Underwriters generally consider three factors:

- **Capacity:** This is a factor that considers the ability of the contractor to perform the obligations of the contract. Evaluation criteria include the contractor's technical skill, management, qualifications of personnel, employee retention, and exposure and progress on other contracts.

- **Capital:** This is a factor that considers the financial strength of the contractor as it relates to its ability to fulfill the terms of the contract. Evaluation criteria include the contractor's financial condition, working capital, debt structure, liquidity, and leverage.

- **Character:** This is a factor that considers the historical performance of the contractor. Evaluation criteria include experience and reputation, industry niche, length in business, and relationships with subcontractors.

These underwriting factors can influence a surety's decision to provide either performance or warranty bonds on projects that use performance specifications. The Surety & Fidelity Association of America (SFAA) issued a white paper entitled "Statement Concerning Bonding Long-Term Warranties" (SFAA 2003), which framed the issue as follows:

> *Some public owners have proposed special warranty requirements in excess of the standard one year warranty of the entire work. Under these warranties, the contractor is responsible for correcting defects in its work that are due to faulty materials and workmanship (materials and workmanship warranty) or correcting any shortfall from established specifications (performance warranties). It is often difficult to determine where the line is between faulty workmanship and materials versus inadequate design, use beyond expectations or maintenance issues.*

While noting that the surety industry understood the desire for quality assurance, SFAA's white paper concluded that bonded long-term warranty requirements limited bond availability, thereby limiting competition for construction contracts, and ultimately increasing costs. SFAA highlighted the pragmatic issues associated with a surety's underwriting process and how it did not align with long-term bonds. According to the SFAA, "as the duration of the bonded obligation becomes longer, and the surety must assess the contractor's operation for periods of time well into the future, the certainty of the judgment will be lessened." Examining the risks described above, as well as the factors for assessing capacity, capital, and character, the overall uncertainty of the contractor's financial situation is of major concern to the surety industry.

SFAA noted during an interview with the authors that the time periods within which bonds are underwritten can also create major underwriting challenges, irrespective of the amount of coverage applied over and above the "normal" one year warranty and bond period. Surety commitments (and hence underwriting decisions) are made at the time of bid. On a reasonably large project, that can mean that the overall commitment (with only a one year warranty) may be 2 to 3 years. The surety takes on the risk of the financial condition of the contractor during that procurement and contract execution time period. If an agency adds on an additional warranty obligation of say five years after completion of the project, then the surety is at risk for the contractor's financial condition for potentially 7 to 8 years. The surety is likely to find difficulty in underwriting and assessing such arrangements.

In addition to the underwriting uncertainties, the SFAA white paper expressed surety concerns over the method of payment for the work under long-term performance-based warranties. The paper noted that under most contracts, the contractor is paid fully upon final completion, leaving no contract balances to fund any warranty work. As a result, if a surety is obligated to step in and complete the warranty work then it cannot avail itself of contract funds to mitigate its losses, as it would if the default took place during contract performance and before final payment.

The SFAA white paper noted that to compensate for the increased risk due to the diminished certainty of underwriting and the method of payment, sureties typically raised their underwriting standards and provided long-term bonds only to the largest and most financially sound contractors – sometimes shutting out smaller contractors who were otherwise qualified to do the work from bidding on these projects.

To mitigate these issues, the SFAA white paper recommended the following:

- Warranties should be limited to one year.
- Any warranty of more than one year should be only from the supplier of the equipment or material and explicitly excluded from the prime contractor's bond.
- Warranties in excess of one year from the prime contractor should not be backstopped by a performance bond, but instead should come from a specific warranty bond required at final acceptance of the construction project – enabling the bonding company to underwrite the financial condition of the contractor at the time the warranty bond is being placed and not years earlier.
- Warranty bonds are for an amount commensurate with the long term warranties and not the entire project – i.e., the warranty should be for a value that corresponds to the reasonable expected cost of implementing the warranty work.

The interview with SFAA also confirmed that sureties had major issues with warranty bonds. It was noted that the amount of the bond, and the underwriting associated with it, was commercially challenging. There was not enough money to be made in the premium for the level of effort required.

The general view of sureties is that they generally are willing to provide warranty bonds as a service to their existing clients in good standing, but do not view it as a separate market focus.

The conclusions of the SFAA white paper are also supported by a survey of several bonding companies (Bayraktar et al. 2006). This survey confirmed the reluctance of sureties to provide long-term warranty bonds because of the detailed underwriting reviews needed, and also when the length of the warranty was extended. Interviewees noted a concern that warranty work was funded by contractors out of working capital, and that this could jeopardize the contractor's financial status. They cited reasons for providing warranty bonds as not being tied to sound underwriting practices, but instead to "responses to competition," "holding on to market share," and "fear of losing large premium producers." The survey also noted a high probability that small companies will be eliminated from warranty projects because of risk and underwriting concerns. The recommendations from this survey included the following:

- Decreasing the warranty period to a maximum of three years.
- Having a renewable annual warranty bond after three years.
- Treating warranty requirements as a separate line item on the project, which would help fund the warranty expense and be an additional incentive to the contractor.

Regardless of whether an agency is considering performance bonds that cover warranty obligations, or separate warranty bonds, the impact to contractors is also an issue to consider. Carrying a bond reduces the contractor's overall bonding capacity, and many contractors have expressed concern that warranty projects will reduce their capacity to take on future work. These bonding concerns have in some cases precluded contractors from bidding or contributed to lower numbers of bidders on warranty projects.

3.2.3 Alternatives to Bonds and Insurance

Surety bonds are not extensively used outside of North America, where contract obligations are secured by letters of credit or similar "demand" instruments that function like letters of credit. These instruments are irrevocable commitments by the issuing bank to a third party beneficiary (the agency) on behalf of a customer of the bank (the contractor) to meet demands for payment. These instruments are for smaller percentages of the contract price (5 to 10%) than a typical performance bond (100%), and are generally tied to a date specific (generally one year, subject to renewal on a yearly basis), payable on demand of the owner. Unlike surety bonds, which are three-party agreements that have the surety obligated to the owner and the contractor, letters of credit only run to the benefit of the owner. As a result, they can generally be drawn upon quickly and easily, since there are few defenses that a contractor can validly raise to stop a draw.

Letters of credit are a viable way of guaranteeing long-term obligations and warranties, and have been used in large public-private partnerships to secure operations and maintenance commitments by developers. However, there are several challenges with their use:

- **Collateral requirements:** Because these instruments are not written based on leveraging assets, the collateral that a contractor needs to have in place to secure the letter of credit can be substantial. Consequently, a $2,000,000 letter of credit can in effect be considered as having $2,000,000 in operating capital tied up for the length of the warranty. As a result, only the largest contractors will likely be capable of supporting multiple long-term warranties or maintenance agreements with collateral being committed for a lengthy time.

- **Risks of the letter of credit being drawn upon:** Unlike surety bonds, where the contractor has the right to argue that it is not in default of a warranty or maintenance obligation, the "demand" feature of a letter of credit generally means that the agency will have the right to draw upon the letter of credit if it believes in good faith that it is correct in its position, and the contractor will have to argue about its rights later. This places substantial emphasis on the underlying risks associated with performance specifications, as discussed earlier.

3.2.4 Default Insurance and Efficacy Insurance

Subcontractor Default Insurance (SDI) emerged approximately 15 years ago as a result of perceived deficiencies with subcontractor performance bonds. The default of a major subcontractor can impact the overall project schedule, expose the general contractor to liquidated damages or other delay-related damages, and affect the work of other subcontractors. Faced with an imminent default by a subcontractor, a general contractor will typically make demand upon the subcontractor's performance bond. Ideally, the surety should be ready, willing, and able to step in and remedy the default. But criticisms have emerged that the response time for the surety to act is too slow given the urgency of the project schedule. Addressing these perceived shortcomings of surety bonds, Zurich created an SDI policy known as Subguard®. It works as a two-party agreement between the contractor and insurance company, with the contractor procuring the policy as the named insured. The general contractor is responsible for prequalifying the individual subcontractors and suppliers into the program. Coverage commences upon a formal declaration of default, but the general contractor is not required to terminate the subcontract.

This type of product is a hybrid of insurance and surety, and gives an owner the right to access an insurance policy if there is a predetermined default, with fewer procedural defenses available to the contractor than would be the case in a surety situation. Subject matter experts were consulted to assess the suitability of SDI for long-term warranties or maintenance agreements on highway projects using performance specifications. At this point, such a product does not exist, and there are concerns as to whether such products will be viable given the nature of the risks.

In other industry sectors, power generation in particular, there have been insurance products created that have been based on efficacy – i.e., insuring the performance of a system or project. These products have been used by extremely sophisticated contractors, who are well-established financially and can absorb large financial risks. Such insurance products are not known to be available for the highway sector as of yet, and given the nature of the contracting community, it is unlikely that this type of product will be available for smaller contractors.

3.2.5 Current Practices

Information derived from the NCHRP 10-68 study on pavement warranties demonstrates an evolving process among the states in terms of warranties and securing the obligations of the contractor (Scott et al. 2011). Some current practices in this regard are as follows:

- **Prequalification of Future Work:** Rather than using a separate financial instrument to secure performance, Florida ties performance during the warranty to prequalification for future work through the use of a "guarantee." If the contractor fails to perform the required remedial work, the contractor is precluded from bidding on future state work for a period of six months, or until the remedial work is completed, whichever is longer. Several other agencies have considered using this program as well, although one of the challenges is that most Florida contractors only work in Florida, and are thereby motivated to work things out with the state. States that contract heavily with out-of-state contractors, or where in-state contractors have alternatives in other states, may not find this as compelling a "guarantee."

- **Pay-for-Performance:** Minnesota has used a pay-for-performance specification, where the contractor is paid a portion of the costs at the time the item is placed, and then is paid on a graduated scale over time if the item performs to expectation. Minnesota implemented this alternative for warranties on its I-494 design-build project.

- **Retainage:** North Dakota has, for some of its projects, held a one percent (1%) retainage for the duration of the warranty in lieu of any bonds or other security.

- **Use of Extended Performance Bonds:** Some state agencies, like California and North Carolina, have extended performance bond coverage to cover warranties of one year or less. The challenge with this approach is that the penal sum of the performance bond may be substantially more than the value of any potential warranty work, and having this bond outstanding will tie up bonding capacity.

3.2.6 Recommendations for Addressing Risks related to Long-Term Performance Guarantees

There are several issues associated with using bonds, insurance, guarantees, and other mechanisms with contracts based on performance specifications, particularly those containing long-term warranty or maintenance obligations. Given the current state of the surety and insurance markets and availability of products, the risks associated with performance specifications on highway projects in general, and the risk of using long-term warranties or maintenance obligations in conjunction with performance specifications, the long-range viability of bonds, insurance, guarantees and other mechanisms cannot yet be ascertained with any reasonable degree of certainty. However, it is fairly clear that it will not be in the best interests of agencies to simply mandate these long-term security instruments without trying to balance the interests of the contracting and the surety/insurance industry. To develop an implementation program that is workable and viable, agencies should consider the following:

- Reach out to the surety and insurance markets and determine how to best create sustainable products that will meet the agency's performance goals.

- Insurers value the track record of experienced highway builders and operators (e.g. European-based), and are welcoming this business, particularly for long-term maintenance and operation commitments under a public-private partnership (P3). Balance the qualifications required from builders/operators to obtain favorable terms for long-term performance guarantees (insurance or other instruments) with the need to generate adequate local competition for these services.

- Consult with states that have more sophisticated transportation department contract offices with mature P3 and long-term operating experience. These agencies will lead the way for other agencies in determining the best approach to guaranteeing long-term performance obligations.

- Give sureties the means to re-evaluate and re-price their commitment to long-term obligations. An option may be to allow the surety to be alleviated from its obligation if there is a predetermined erosion of the principal's financial condition, or if the surety no longer underwrites the principal.

- Adopt some of the recommendations in the SFAA report, such as the use of shorter-term warranty (vs. performance) bonds and structure payment of the warranty obligations as a line item, similar to the North Dakota approach with retainage.
- Decide whether Florida's "prequalification" and "guarantee" model is appropriate within the state to secure financial performance.
- Work with manufacturers who are willing to provide "product" guarantees of performance.

3.3 Garnering Industry Support

Traditionally, agencies retain the risk associated with the performance of a project through the use of standard method specifications under a low bid contract, and achieve minimum performance through process control, material testing and inspection of the work during construction. Performance specifications move away from this traditional model for assuring performance by transferring performance risk to the industry. The transition from method to performance requirements has been evident in pavement construction. For example, "standard" Quality Assurance (Q/A) specifications for pavements require contractors to produce mix designs based on criteria and tolerances specified by the agency. These specifications allocate responsibility for quality control and testing to the contractor and establish targets for construction quality characteristics with incentives (disincentives) for achieving higher (reduced) quality compared to the target values. Pavement warranty provisions also shift greater responsibility for post-construction performance to the contractor by providing greater latitude in design and construction, in turn, requiring that pavement meet or exceed specified performance targets during the life of the warranty.

Highway agencies and industry are continually looking for ways to innovate to improve performance. Performance specifications can provide a platform for agency or industry-initiated innovation. At the lowest level, a performance specification can prescribe new materials, processes or technology (e.g. mechanistic mix designs for pavement, rapid non-destructive test methods) to enhance performance with the agency retaining the majority of performance risk. As the industry gains experience, the agency can gradually eliminate prescriptive requirements and shift performance responsibility to industry.

At the highest level, performance specifications eliminate prescription, expressing requirements in terms of end user or functional end result requirements and allowing industry the greatest latitude to innovate. There are obvious risks related to shifting performance responsibility to industry, as addressed in this chapter. To successfully implement performance specifications, agencies must collaborate with industry (and suppliers) in setting goals and identifying realistic performance parameters and targets to meet goals. Quite often initial investments are required for both the agency and industry to change roles and responsibilities, develop knowledge and skills, modify standard procedures, and perhaps acquire new equipment or technology. To ease the transition and spread out the cost of the initial investment performance specifications can be implemented as a phased progression over time. For example, as described in Volume II of these Guidelines, an agency may approach the implementation of performance specifications for pavements using a phased or tiered approach that starts with a minimal departure from current practice and transition to a substantial shift in technology and business practices to improve performance. Volume II further addresses the development and use of incentive strategies and payment mechanisms as reward mechanisms in performance specifications to motivate industry to enhance performance.

CHAPTER 4

Legal Perspective of Performance Specifications

4.1 DESIGN VS. PERFORMANCE SPECIFICATIONS

4.2 DEFENSES TO MEETING A PERFORMANCE SPECIFICATION

Impossibility and Impracticability of Performance
Owner Involvement and Interference

Chapter Objectives

This chapter:

- Presents an overview of key court decisions addressing the enforceability of performance specifications
- Discusses the application of the *Spearin* doctrine to performance specifications
- Addresses possible lines of defense for failing to meet performance specifications

4. Legal Perspective of Performance Specifications

The guidance and recommendations contained in this document primarily stem from best practices and lessons-learned as identified from a review of published reports, guidance documents, and contracts and specifications, and discussions with subject matter experts from agencies and industry. However, in implementing performance specifications, users should also be aware of the various legal precedents that may affect their enforceability. This section is therefore intended to provide an additional view of performance specifications – that of the courts.

There have been a substantial number of reported decisions addressing the enforceability of performance specifications. Most of these cases are based on disputes involving federal government contracts, and have been reported in decisions by various agency Boards of Contract Appeals (BCAs) and the United States Court of Federal Claims (COFC). Set forth below is an overview describing the most common topics discussed in the cases.

4.1 Design vs. Performance Specifications

Whether a contractor's performance is governed by a design (i.e., prescriptive or method) or performance specification is critical for determining liability for project defects. When an owner specifies the material and character of the work by using "design" (or method) specifications, the owner impliedly warrants that as long as the work is performed by the contractor as specified, the contractor will not be responsible for the consequences of design defects [*U.S. v. Spearin*, 248 U.S. 132 (1918)]. This long-standing principle, called the *Spearin* doctrine, has been a cornerstone of construction law in the United States for almost a century, and has helped shape the basis for current practices in construction contracts and project management.

As the construction industry has moved to performance specifying, there has been much discussion over the application of the *Spearin* doctrine to performance specifications and the consequent liability of the owner. Many of the cases before the BCAs and COFC evaluate whether the particular specification in dispute is a design specification, performance specification, or a mixture of the two.

Generally speaking, a "design specification" is one that describes in precise detail the manner and method of the construction work to be performed and from which the contractor is not allowed to deviate [*J.L. Simmons Co., Inc. v. United States*, 412 F.2d 1360 (Ct. Cl. 1969)]. Courts and BCAs refer to these specifications as "road maps," "cookbooks," and similar adjectives that say, in essence, that a design specification dictates "how" the contractor is to do the work. In contrast to design specifications, a "performance specification" sets forth an objective, result or standard, and the contractor has discretion as to the means of achieving it [*Kiewit Construction Co. v. United States*, 56 Fed. Cl. 414 (2003)]. In classic performance specifying, the owner will not state design, measurements, or other specific details, and will simply state the expected result.

It is also common for a particular specification to be a mixture of design and performance specifications. For example, if a bridge project involved the driving of concrete cylinder piles, a performance specification might say, "Drive the 50 foot diameter piles to a minimum tip elevation of -55 feet and to a bearing capacity of 650 tons." A mixed design and performance specification might add requirements such as hammer size, cushion replacement, jetting limitations, maximum stress levels in driving the piles, and similar restrictions.

As noted above, the distinction between a design and performance specification is critical in assessing liability. If a contractor complies with a design specification that does not work, then, under the *Spearin* doctrine, the contractor is given cost and time relief. On the other hand, if the specification is considered a performance specification, then it is the responsibility of the contractor to achieve it, regardless of how much it costs. While this is a relatively easy-to-understand concept, the big problem comes when an owner prescribes a mixed design and performance specification, where performance cannot be achieved under the design constraints established by the owner.

For example, in the bridge scenario described above, assume that the specification precluded any type of pre-jetting. When the contractor starts driving the piles, it finds that it is exceeding the maximum stress levels, and that the piles are starting to crack at elevations well above the minimum tip elevation. Assume that the owner and contractor agree that the solution to this is to pre-jet to within 5 feet of the minimum tip elevation, which operation costs the contractor more money and time. The contractor's argument would be that the owner's specifications were defective, in that the design requirements led it to believe that it should not price pre-jetting operations. If the owner believed that it had drafted a performance specification, then it would disagree with the contractor's claim for money and time. The issue, of course, is that because the owner constrained the contractor's ability to do the work by establishing some "cookbook" requirements, the owner's argument will likely fail.

There are numerous reported cases that evaluate this type of issue. A recent design-build case, *White v. Edsall Construction Company, Inc.* [296 F.3d 1081 (Fed. Cir. 2002); See generally Loulakis 2002], explains the principle. The contract involved the construction of an aviation support facility for the Army, and the issue was the design of the storage hanger tilt-up canopy doors and trust. The specifications required the design-builder to use a three-point pick system to lift the doors. The design-builder eventually concluded that the three-point system was deficient, and made a claim for its costs in modifying the lifting system. The Army argued that it was a performance specification, and specifically that liability for the deficient three-point pick system was to be borne by the design-builder through the following note, which was on the canopy door drawings:

> *Canopy door details, arrangements, loads, attachments, supports, brackets, hardware, etc. must be verified by Contractor prior to bidding. Any conditions that require changes from the plans must be communicated to the Architect for his approval prior to bidding and all costs of the changes must be included in the bid price.*

The Armed Services Board of Contract Appeals (ASBCA) found the three-pick design system to be a defective design specification, and rejected the disclaimer language. The ASBCA found that the Army had warranted that the door load could be evenly distributed to the specified three pick points and that the disclaimers could not be read to eliminate this warranty. It said that if the number of picks was not a design specification, then “bidders would have been free to select the method of performance, and it would not have been necessary for them to seek the architect’s permission to make changes from the plans.” Importantly, the ASBCA stated that the design-builder had no pre-bid obligation “to ferret out if the Government’s three-pick point design would provide the proper load distribution.”

Given the number of cases that have considered this issue, it is clear that the owner bears the risk of a mixed design and performance specification that does not work. Efforts by owners to avoid this risk by using creative labels have not been successful. This would include: (a) calling a design specification “performance specification requirements,” (b) stating that the design specification is “discretionary,” (c) using disclaimers of liability, and (d) saying that the design specification is “for guidance purposes only.” Stated simply, the BCAs and COFC, as well as state courts, view the *Spearin* doctrine as an important right for contractors and they have been reluctant to accept the arguments of owners that would compromise this right.

It should be noted that these cases involved design-build delivery where it is commonly assumed that control and liability for design is shifted from the owner to the contractor. In reality, design-build or design-bid-build performance specifications may contain a mix of design requirements (or constraints) and end result performance requirements. The design constraints may restrict the contractor’s ability to provide a preferred or lowest cost solution but should not prevent the contractor from meeting the required performance. A simple example of a design constraint would be prohibiting the use of steel construction for a bridge to reduce future maintenance cost. As a best practice, when drafting specifications containing design constraints and end result performance requirements, the drafter should clearly define roles and responsibilities and performance requirements, and ensure that design requirements or restrictions do not prevent a contractor from reasonably meeting the required performance.

4.2 Defenses to Meeting a Performance Specification

There are numerous cases where pure performance specifications have cost a contractor more money than expected and where they have sought relief. The cases are clear on this. When a contract is properly written in terms of a clear performance specification with end result requirements, courts will not be hesitant to find the contractor liable for failing to meet such specifications. Consider *Utility Contractor, Inc. v. United States* [8 Cl. Ct. 42 (1985)], in which a contractor was to design and build a flood control system to collect rainwater along a creek in Oklahoma and prevent the construction area from flooding. Rainstorms caused the creek to overflow temporary cofferdams installed to keep the construction area dry. The contractor alleged that the government had failed to identify detailed procedures in the contract for protection of the permanent work during the construction phase. The court rejected the claim based on its reading of the contract, taken as a whole, as requiring the contractor to possess sufficient hydrological expertise and construction skills to protect its unfinished work.

However, despite this general principle, there are questions as to how far this obligation will actually extend when the contractor is confronted with factors beyond its reasonable control. Although there are few cases on this subject, two lines of defense have surfaced — impossibility/impracticability of performance and owner interference.

4.2.1 Impossibility and Impracticability of Performance

If an owner creates a performance specification that is, for technological or financial reasons, impossible or impracticable to perform, courts may excuse the contractor’s non-performance. The factors to be considered in establishing “impossibility” are: (a) whether any other contractor was able to comply with the specifications; (b) whether the specifications require performance beyond the state of the art; (c) the extent of the contractor’s efforts in meeting the specifications; and (d) whether the contractor assumed the risk that the specifications might be defective [*Oak Adec, Inc. v. United States*, 24 Ct. Cl. 502 (1991)]. Commercial impracticability is a subset of the legal doctrine of impossibility, and excuses a party’s delay or nonperformance when the “attendant costs become excessive and unreasonable by an unforeseen supervening event not within the contemplation of the parties at the time the contract was formed” [*L. W. Matteson, Inc. v. United States*, 61 Fed. Cl. 296 (2004)].

By accepting a performance specification, it can be argued that the contractor has represented to the owner that the specifications are attainable and subject to neither defense. However, courts have considered this matter more precisely and have evaluated (a) the precise contract terms agreed upon by the contractor and (b) the relative knowledge of the owner and contractor regarding the "impossible specification."

In *Colorado-Ute Electric Association v. Envirotech Corp.* [524 F. Supp. 1152 (D. Colo. 1981)], the design-builder (Envirotech) agreed to meet certain performance requirements in its contract to provide the owner (Colorado-Ute) with a hot-side electrostatic precipitator at a coal-fired electric power plant. Specifically, Envirotech agreed to comply with state air quality standards requiring that emissions opacity would not exceed twenty percent and warranted that it would bear the cost of all corrective measures and field tests until continuous compliance could be achieved. Envirotech failed to achieve continuous compliance with the performance requirements and claimed that such compliance was "impossible" to accomplish. The court held that Envirotech had expressly warranted that it could provide Colorado-Ute with a satisfactory precipitator and thus assumed the risk of impossibility. The court stated, "[Envirotech's] impossibility defense is inconsistent with its express warranties and cannot be employed to avoid liability."

Similarly, in *Aleutian Constructors v. United States* [24 Cl. Ct. 372 (1991)], the Court of Claims held that by altering the owner's initial design specifications for the design features at issue, the contractor had impliedly assumed the risk that performance under its proposed specifications may be impossible. In this case, the contractor, Aleutian, agreed to construct an airplane hangar and dormitory building for the Air Force's Optical Aircraft Measurement Program at Shemya Air Force Base, Alaska. The area is known for its extreme weather conditions and high winds.

During construction, Aleutian obtained the government's approval to change the design of the roofing system provided that it warrant the materials and workmanship for a five-year period and verify that the proposed design would withstand a wind uplift pressure of 80 psf. Soon after installation, the roofing system failed and Aleutian was forced to make substantial repairs and modifications to the roofing system. Aleutian filed a claim to recover the repair costs, alleging defective specifications and impossibility. The court rejected the claim and reasoned that when the contractor persuades the owner to change its design to one proposed by the contractor, the contractor assumes the risk that performance under its proposed design may be impossible. Accordingly, by assuming responsibility for the design, the contractor assumed liability for all damages and losses arising from the inability of the design to meet the owner's performance goals.

Yet another instructive case in this area is *J.C. Penney Company v. Davis & Davis, Inc.* [158 Ga. App. 169, 279 S.E.2d 461 (1981)], where the issue involved the quality of workmanship of certain sheet metal and coping work. The project specifications provided that the work must "be true to line, without buckling, creasing, warp or wind in finished surfaces." The owner refused to accept the work because it did not comply with the specifications. The design-builder did not dispute the assertion that the work did not comply with the specifications, but instead claimed that it was impossible to comply with the specifications. The court found that impossibility is not a basis to allow the design-builder to recover its additional costs from the owner for attempting to comply with the specifications. The court reasoned that the specifications, although impossible to meet, were negotiated by the parties at arm's length. Therefore, the owner was totally within its rights in refusing a product that did not meet all of its bargained-for specifications.

As evident from the above cases, one of the biggest hurdles that a contractor faces relative to these defenses is the argument that they have assumed the risk of meeting the performance specification. This is particularly true in a design-build context, where the contractor may actually have participated in the development and writing of the specification. Therefore, while these defenses are theoretically available to a contractor, few tribunals have accepted the arguments.

4.2.2 Owner Involvement and Interference

An owner can potentially jeopardize its rights to shift the risk of achieving performance specifications to the contractor by interfering with the design or construction process. Consider, for example, *Armour & Company v. Scott* [360 F.Supp. 319 (W.D. Pa. 1972), aff'd, 480 F.2d 611 (3d Cir. 1973)], which arose out of a design-build contract for the construction of a meat packing plant. The court found that the owner became so actively involved in the design process by modifying the electrical and mechanical systems and ultimately increasing the facility size that the owner assumed the role of a *de facto* partner of the design-builder. These substantial interferences constituted a breach of contract by the owner.

Sometimes, despite the best efforts of the owner to develop a performance specification and enable the design-builder to meet it, circumstances related to owner involvement can impact the single point of responsibility. Consider, for example, *Allen Steel Co. v. Crossroads Plaza Associates* [1989 Utah LEXIS 124, at *1 (Utah Oct. 6, 1989), op. withdrawn, 1991 Utah LEXIS 30 (Utah Apr. 10, 1991)], which involved a commercial facility in Salt Lake City, Utah. In response to an owner's solicitation of design-build proposals for structural steel work, a contractor submitted in its proposal three structural design alternatives. However, the proposal specifically stated the following:

> *This proposal is offered for the design, fabrication, and erection of the Structural Elements only for the tower and mall. * * * Owner's engineer is to check this design and make changes if necessary to enable him to accept overall responsibility for the design. Changes that effect [sic] quantity, weight, or complexity of structural members will require an adjustment in price.*

The proposal was accepted and the contractor was directed to prepare detailed plans for steel fabrication based on its plans.

During the course of performance, however, inspectors from Salt Lake City stopped construction due what they perceived as structural defects. The owner retained its own engineer to correct the defect. Steel had to be torn down to remedy the problem, resulting in delays to the project and substantial cost overruns. The owner backcharged the contractor for such costs, prompting litigation between the parties.

The sole issue in the case was whether the contractor had effectively disclaimed responsibility for design defects by placing responsibility for the design within the control of the owner through its proposal. The court found that although the owner had only provided general design parameters for the structural steel, the contractor had effectively disclaimed its responsibility, since it had provided a design for purposes of the bid and transferred the risk of verifying adequacy of the design to the owner.

CHAPTER 5

Deciding to Use Performance Specifications

5.1 PROJECT-LEVEL CONSIDERATIONS

Project Characteristics
Scoping Issues

5.2 PROJECT DELIVERY CONSIDERATIONS

Chapter Objectives

This chapter addresses the following questions:

- Under what conditions would one use performance specifications instead of traditional method specifications?
- How does project delivery affect the decision to use performance specifications?

5. Deciding to Use Performance Specifications

Performance specifications are not ideal for every construction contract. However, they may hold significant advantages over traditional method specifications when certain criteria or conditions are met.

To help agencies identify and understand these conditions, this chapter presents a two-part decision process for evaluating when to use or not to use performance specifications. Part 1 of this decision process, as outlined in Figure 5.1, is based on a project's scope and goals. Part 2, as summarized in Figure 5.2, then addresses the project delivery considerations that could also affect the decision. A more detailed discussion of the decision process follows these figures.

When proceeding through this process, it is important to note that the decision to use method or performance specifications is often a matter of degree (how much and at what level). Different approaches to specifying may be appropriate to specific elements within a project. It is therefore possible, if not likely, for a project to include both method and performance requirements. In practice, this means that to develop and write effective performance specifications, the screening process described in this chapter should be followed by a more in-depth evaluation of the type and level of performance requirements appropriate for the project characteristics and contracting type (as described in Volume II, Chapter 2 of these Guidelines).

Although a single person could perform this evaluation, it is advisable to instead assemble a multi-disciplined team to provide for a more balanced and accurate selection process. Personnel for a selection team could include planners, designers, and construction and maintenance personnel. It may also be useful to consult with representatives from local industry to obtain their perspective on performance specifications.

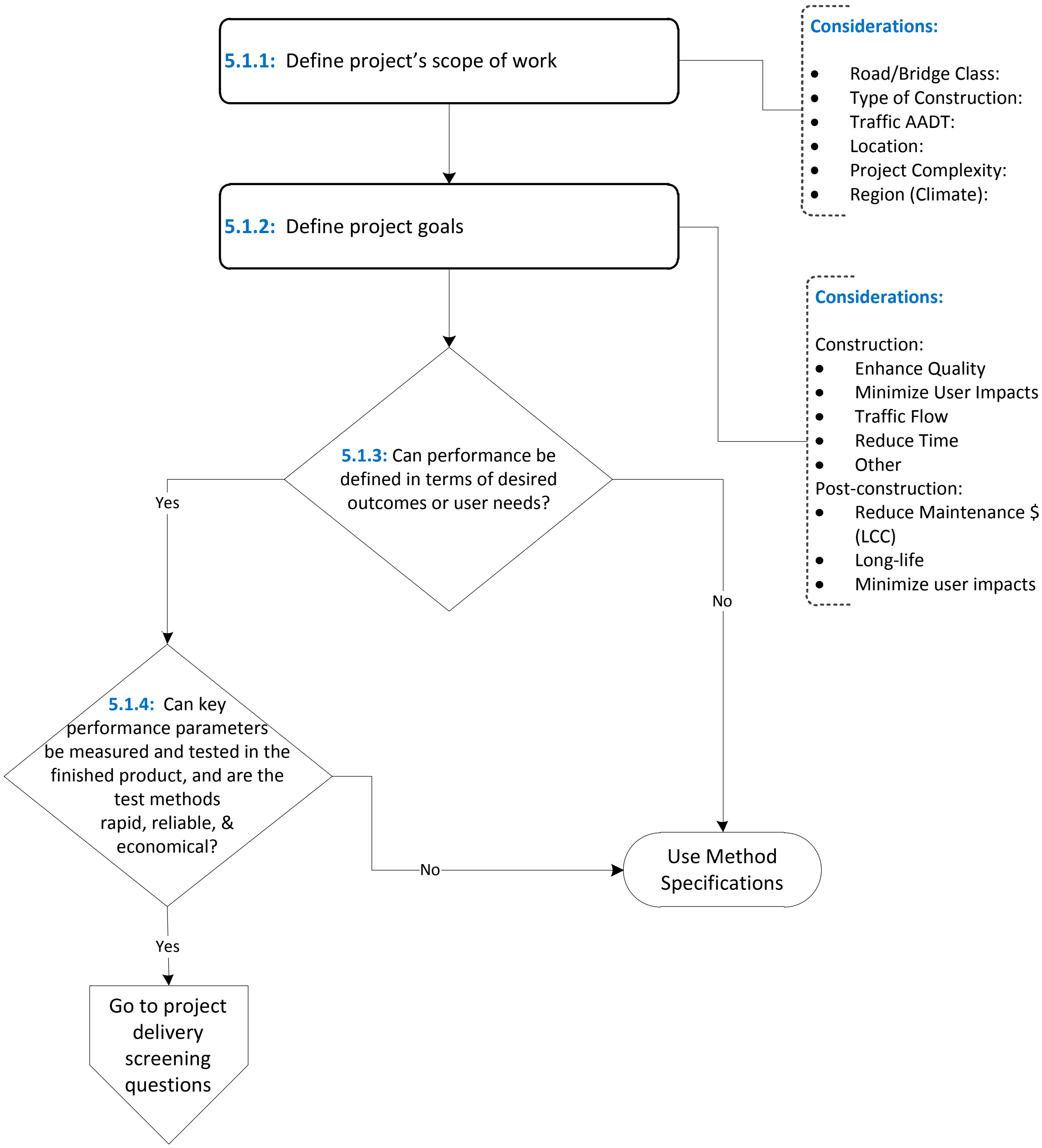

Figure 5.1: Decision Process Part 1: Project Level Considerations

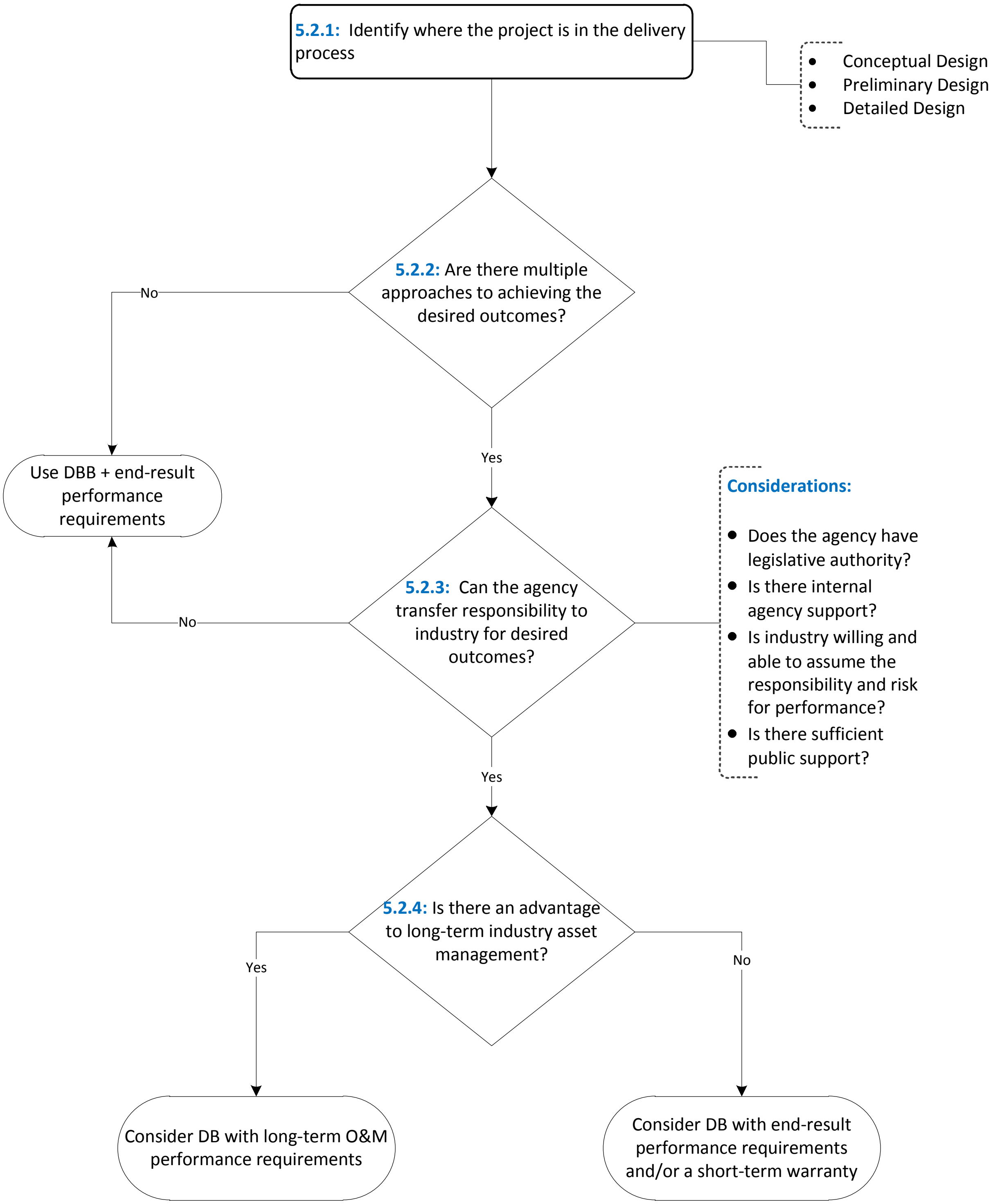

Figure 5.2: Decision Process Part 2: Project Delivery Considerations

5.1 Project-Level Considerations

5.1.1 What is the project scope of work?

Project scope is a key issue when deciding whether or not to use performance specifications. Although performance specifications have been applied to a wide range of transportation project types, experience has indicated that certain conditions are more likely to yield a successful outcome than others.

Project Characteristics. Table 5.1 summarizes the typical conditions under which method and performance specifications can be best applied.

Table 5.1: Appropriate Conditions for Using Method vs. Performance Specifications

Method Specifications	*Performance Specifications*
• End product performance cannot be easily defined. • End product performance cannot be easily or economically measured and verified. • Limited methods exist that would satisfy the agency's minimum requirements. • The agency must retain performance risk because of permit requirements, maintenance considerations, need to tie into existing or adjacent construction, and similar issues. • Removing and replacing defective work would be impractical. • Pre-existing conditions would compromise the transfer of performance risk to the contractor.	• End product performance can be defined in terms of desired outcomes or user needs. • Key performance parameters can be measured and tested, and the test methods are rapid, reliable, and economical. • There are multiple approaches to achieve the desired results. • Industry is willing to assume performance risk. • Agency is willing to relinquish control over some aspects of the work.

The likelihood of realizing the advantages of each specification type tends to correlate with project complexity. Performance specifications are typically most advantageous when the nature of the project provides ample opportunity for the industry to innovate and influence performance outcomes, as is often the case on complex projects involving major reconstruction or new capacity, multi-phased work zone management, major or non-standard structures, and high traffic volumes requiring accelerated design and construction.

In contrast, non-complex projects involving minor resurfacing or restoration of the pavement surface or use of standard structural components to match existing facilities tend to be the least likely project types to benefit from using a performance specification unless the agency allows significant latitude through the selection of alternate designs, materials, or construction methods.

Scoping Issues. Pre-existing conditions can significantly limit the ability of performance specifications to shift performance risk to the contractor, particularly for project elements subject to an extended warranty or maintenance period. For such situations, the contractor's scope of work should include activities to correct any pre-existing conditions that could potentially affect performance. Alternatively, if the scope of work does not address underlying deficiencies, the specification should identify exclusions relieving the contractor of responsibility for performance problems stemming from pre-existing deficiencies.

If the risk associated with underlying conditions cannot be allocated to the contractor in an equitable manner, it may be necessary to modify the scope of the performance specification to exclude certain sections of the work or to eliminate certain performance requirements all together. These scoping considerations should be factored into decisions regarding whether and how to use performance specifications for specific project elements.

Also, many projects involve reconstruction of facilities while maintaining traffic flow. Agencies traditionally provide prescriptive requirements for maintenance of traffic and project phasing in the construction plans. The agency must decide whether retaining such control is too restrictive when specifying time-based and/or quality-based performance requirements for a project. For example, on more complex projects with higher traffic volumes, it may be beneficial to shift control of work zone management and phasing to the contractor, particularly when using alternate procurement methods or a design-build contract. This would allow the contractor to plan and phase the work in a manner that best suits its design and construction operations.

5.1.2 What are the project goals or desired outcomes?

In addition to project scoping, the agency should identify and prioritize the key goals or specific outcomes desired for a project. As shown in Figure 5.3 these outcomes may focus on construction or may extend to post-construction performance.

As an initial task, the project team should identify desired goals and rank the objectives in order of importance. One approach used to determine rankings is to rate or score the relative importance of project goals in a committee forum on a

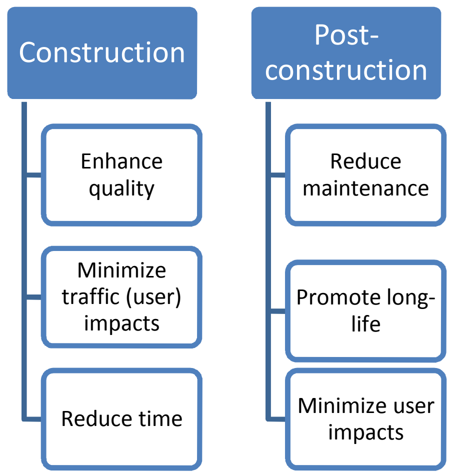

Figure 5.3: Possible Project Goals for a Rapid Renewal Project

scale (for example 1 to 10, with 10 being extremely important to project success and 1 being minimally important). The ratings can then be compiled and averaged to determine the relative ranking of goals in order of importance.

To the extent possible, the goals should be based on definitive criteria (for example, time savings in days or annual maintenance cost in dollars). Goals that are more subjective in nature will benefit from a group discussion to determine their relative importance.

It may be possible to achieve multiple goals in a rapid renewal context, but the project team must first assess whether performance specifications are the best solution to achieve the desired outcomes. To this end, the next steps in the decision process are designed to help determine whether goals can be described, measured, and tested in terms of end-product performance.

5.1.3 Can performance be defined in terms of desired outcomes or user needs?

Once project characteristics and desired outcomes have been identified, there are some basic issues to be considered to determine the feasibility and practicality of using performance specifications. As a first step, it is necessary to determine whether project goals or desired outcomes can be defined in terms of key end-result performance parameters that are within the contractor's control. Such parameters may relate to the operational or end-result performance of the finished product (e.g. pavement ride quality), or to functional parameters that are more indicative of actual product performance over time (e.g. surface distresses such as rutting or cracking as used in a pavement warranty provision). Desired outcomes may also include time performance in terms of construction time or traffic delays in the work zone.

5.1.4 Can key performance parameters be measured and tested in the finished product or monitored over time, and are these test methods rapid, reliable, and economical?

Given the existence of valid performance parameters, the next step is to determine whether these parameters can be measured and tested rapidly, reliably, and economically. For example, non-destructive testing techniques may be able to reduce some of the delay associated with quality assurance and acceptance activities, especially if results are available in real-time or within a matter of days. Similarly, techniques that could minimize traffic disruption (e.g., by ensuring timely opening of roadways after a construction project or by eliminating the need for lane restrictions during warranty or maintenance periods) would be preferable to those that would impair mobility.

If the measurement strategy is difficult to achieve in a rapid renewal context, or if potential gaps such as those identified in Table 5.2 exist, the extent to which a performance measurement strategy can be based solely on end-result or functional requirements is limited. For this reason, performance specifications must often incorporate some more prescriptive materials and construction-related properties to act as surrogates. (For example, density and moisture content are commonly used as surrogate properties in acceptance plans and payment schedules for soils even though they do not provide as direct an indication of future performance as would a modulus value.)

In the absence of surrogate measures, a gap may also have the wider effect of eliminating the use of performance specifications to achieve project goals, in which case traditional method specifications may provide the best option.

Table 5.2: Potential Gaps Associated with Performance Specifications

Gap	*Considerations*
Technology gap	• Can a particular parameter be measured and evaluated using existing technology? • Are standardized tests available? • Do the tests provide repeatable results? • Will both the agency and contractor have confidence in the ability of the measurement strategy to yield reliable results? • Are "referee" tests available if the agency or contractor disputes the results of the initial testing? • Is the approach quantitative? If not, is it possible to minimize the subjectivity of qualitative measures by requiring the parties to reach agreement as to what constitutes acceptable performance prior to construction (e.g., through the use of trial sections)?
Sampling & testing gap	• Can the data be collected, processed, and analyzed in a timely manner to influence and improve contractor operations? • Can sampling and testing be conducted in a manner that has minimal impact on traffic and lane closure? • In comparison to other testing techniques (or use of method specifications), is the measurement and testing economical? Is a major capital investment required? • Do the measurement techniques require a high skill level from technicians? Are special certifications necessary? • Is specialized equipment necessary? If so, should the contractor provide this equipment or should the agency? • Does sampling provide continuous coverage?

Gap	*Considerations*
Knowledge gap	• Are the main factors affecting performance for a particular parameter known and understood? • Would a typical contractor know how to control its materials and processes to meet a particular performance standard? • Is there sufficient experience or historic data to properly calibrate design or predictive models?

5.2 Project Delivery Considerations

If it appears, based on Part 1 of the decision process (as described in Section 5.1), that there are significant advantages to using a performance specification to achieve project goals, an additional set of decisions should be made to address project delivery.

The project delivery approach will affect the extent to which the agency can or should transfer responsibility for design, materials, construction, and possibly post-construction maintenance and operation to the private sector (a decision that will also be driven by the degree of flexibility inherent to the project scope). In this context, project delivery refers to the overall contracting and procurement process for a project, inclusive of design, construction, and maintenance and operation phases. Figure 5.3 compares the range of delivery systems applicable to performance specifications. (Note that for the case of Construction Manager at Risk (CMR), the performance specifications would be similar to those implemented under design-bid-build).

	Design-Bid-Build	Design-Build	Warranties	Design- Build-Operate-Maintain
Contractual Roles:	• Agency retains design responsibility • Quality management by contractor • Verification testing by agency • Acceptance at end of construction by agency • Post-construction maintenance & asset mgmt by agency	• Design criteria by agency • Final design by contractor • Quality management by contractor • Verification testing by agency • Acceptance at end of construction by agency • Post-construction maintenance & asset mgmt by agency	• Design by agency (if DBB) • Quality management by contractor • Verification testing by agency • Acceptance at end of construction by agency • Asset mgmt by agency • Warranty by contractor	• Performance criteria by agency • Design by contractor • Quality management by contractor • Verification testing by agency • Post-construction maintenance & asset mgmt by contractor • Performance monitoring by contractor and agency
Specification Strategy:	• Construction acceptance criteria based on surrogate or end-result properties	• Construction acceptance criteria based on surrogate or end-result properties	• Construction acceptance criteria based on surrogate or end-result properties • Post-construction performance based on functional properties	• Performance criteria is based on functional and high-level operational parameters
Procurement Approach:	• Procurement will likely be Low Bid (cost only), but may incorporate additional cost factors related to time or bid alternates in the selection process	• Procurement may be based on low-bid (cost only) or best-value incorporating cost and other factors related to performance in the selection process	• Procurement may be based on low-bid (cost only) or best-value incorporating cost and other factors related to performance in the selection process	• Procurement will likely be a best-value process, incorporating cost and other factors related to performance, or a qualifications-based negotiation

Figure 5.4: Alternative Delivery Systems

The choice of delivery method will affect the level of control and risk that can be shifted to the contractor. To help select a delivery system that is compatible to a given project's characteristics and goals, the project team should consider the questions discussed below.

5.2.1 Where is the project in the development process?

The first step in selecting a project delivery approach is to identify where the project is in the overall development process. Are the elements of the work in the conceptual design stage or in the detailed or final design stages? These stages are defined differently by various highway agencies, but, in essence, they relate to the extent that the project design has been defined with regard to geometry, alignment, materials selection, right-of-way, environmental clearances, traffic phasing, and other key project elements.

In general, a project with greater design definition (more detailed or final design) offers fewer opportunities for a contractor to innovate or provide alternate design or construction solutions under performance specifications. This situation would drive the decision towards using a traditional design-bid-build (DBB) delivery system with some level of end-result specifications.

5.2.2 Are there multiple approaches available to achieve the desired outcomes?

If the project is in the preliminary or conceptual design phase, but still requires the use of a standard design or a specific component to match existing facilities, or the project scope is non-complex and allows for little flexibility or innovation, then traditional DBB delivery with some end-result requirements would be appropriate.

If the project is larger, more complex and multi-faceted, has a relatively low level of design definition, and allows multiple solutions to achieve the desired outcomes through alternate designs, materials, or construction methods, then design-build (DB) and its variations may provide a better means of achieving the project goals.

5.2.3 Can the agency transfer responsibility for design, materials, and construction or traffic management to the industry?

The choice of delivery method affects the extent to which control and risk can be shifted to the contractor. Under traditional DBB delivery, the agency will retain the majority of the performance risk related to design, while the contractor will assume responsibility for those aspects of performance related to materials and construction workmanship.

If moving to DB and/or post-construction warranty or maintenance agreements, the responsibility for design, materials, construction, traffic, and asset management can be shifted in varying degrees to the industry. The additional questions below can be used to determine the feasibility of transferring some of these responsibilities.

Does your agency have the legal authority to use alternative project delivery methods (these may include DB, with or without warranty, or long-term maintenance agreements)? If the agency has legal barriers to implementing alternative delivery and procurement methods, then application of performance specifications may only be possible under a DBB approach by specifying performance-related or end-result construction requirements.

If legal barriers exist, either related to the use of DB, warranty provisions, or best-value procurement, then the agency may need to first obtain special legal authority to test the alternative delivery methods under an experimental or pilot program before gaining support for broader legislative authority.

Is there public support for alternative delivery? Performance specifications may require a higher initial investment. It is therefore important to consider if the public and legislators will be receptive to this higher initial cost, particularly if benefits will not be realized until far in the future.

Is there internal agency support for using alternative delivery? As discussed in Chapter 2, performance specifications change the traditional roles and responsibilities of agency and contractor personnel, which could affect the way a project is administered and inspected. Agency personnel must be willing to relinquish control in some areas in exchange for the contractor accepting more performance risk. The agency may find it beneficial to provide training and support for its staff to ensure that any changes in traditional roles and responsibilities are adequately and consistently communicated and enforced. For example, if the agency is not going to be performing the same level of inspection, personnel would have to be aware of the quality management, testing, and recordkeeping required of the contractor to ensure adequate performance. Note that one approach used successfully by several agencies is to set up a special projects group (or innovative contracting office) dedicated to alternative delivery to develop internal support and staff experience.

Is the industry able to assume the performance risks? Quite often the industry's appetite for risk determines whether a performance specification is feasible. Under performance specifications, contractors that have come to rely on owners to specify materials and construction processes would have to take on greater responsibility for keeping up with the state of practice. If the local contracting community has limited resources and expertise or is averse to being held responsible for performance outcomes, then performance specifications may not provide the best option.

The agency must therefore carefully gage the interest and ability of the industry to respond to alternative delivery and procurement requests. If the industry is not prepared or is unable to assume performance risk, the result may be less competition, and potentially higher costs when implementing a performance specification.

For projects involving a warranty or post-construction maintenance agreement, it is also important to obtain cooperation from the surety industry. Sureties may be reluctant to participate in a project subject to a performance warranty (e.g., 5 to 10 years for pavements). As addressed in Section 3.2, for sureties, unwillingness to offer a bond often boils down to the uncertainty regarding risks associated with long-term performance specifications. As a result, sureties may either not offer a bond or increase the premiums on the bond to cover perceived risk, which translates to higher bids.

If the answers to the above questions are generally positive and support the transfer of responsibility for performance to the private sector, then DB with or without a short-term warranty would be an appropriate delivery option for the agency. The last step to consider would be whether or not there would be a need or an advantage to including private sector asset management in the alternative delivery system.

5.2.4 Is there an advantage or need for private sector asset management or equity in the facility requiring long-term operation and maintenance (O&M)?

Some agencies may perceive a need or benefit to outsource the long-term asset management of a facility. This may be in the form of a long-term O&M agreement or a public-private partnership agreement. From the agency's perspective, private sector asset management may fill a gap in the agency's resources, reduce its cost of inspection and maintenance, or allow the project to be constructed sooner than available public funds would allow. From the industry's perspective, there may be the potential for a higher rate of return through innovation or performance incentives, and the opportunity for a long-term return on investment.

Typically, the private sector would incur significantly more risk for performance under such long-term agreements. The payment terms found in these agreements often require the industry to finance certain front-end costs of the project (e.g., planning, design, construction, etc.) to be recouped as part of toll revenue or other periodic payments during the O&M phase of the agreement. These payments are dictated in part by the ability of the contractor to meet certain performance targets and operational (usage) goals of the facility.

A number of conditions must exist to allow for long-term private sector asset management of a transportation asset (roadway, bridge, or transportation corridor). These include:

- The agency has the legislative authority to toll or transfer the responsibility and risks for asset management to the private sector.

- The intended performance of the facility over time can be described in terms of functional performance parameters that can be measured and tested during the O&M period and at hand back (or turnover) to the agency.

- The industry is capable of entering into a long-term O&M agreement and meeting the performance goals for the facility with a reasonable return on investment.

If the project does not meet these conditions or the industry is not suited for long-term asset management, the agency should instead consider using DB with a short-term performance warranty.

Chapter 6

Project Delivery and Procurement Considerations

6.1 Performance Specifications and Project Delivery

Design-Bid-Build (DBB)
Design-Build (DB)
Performance Warranties
Design-Build-Operate-Maintain (DBOM)

6.2 Procurement Considerations

Cost-Based Procurement Options
Best-Value Procurement
Negotiated Procurements (for DBOM)

6.3 Incentive Strategies

Quality-Related Pay Adjustment Factors
Time and Other Performance-Related Incentives
Pay Adjustments and Contract Delivery

Chapter Objectives

This chapter addresses:

- How the selection of performance requirements can vary with project delivery method
- Various alternatives to the traditional fixed-price, sealed-bid procurement process and the potential advantages they offer
- The use of quality and other performance-related pay adjustment strategies to motivate contractor behavior

6. Project Delivery and Procurement Considerations

If an agency's objective in using performance specifications is to enhance quality, promote innovation, and/or shift performance risk to the industry, traditional design-bid-build (DBB) delivery used with a fixed-price, sealed bid procurement process may not always offer the best approach to selecting a contractor and delivering a project. Various alternatives to the traditional process are therefore discussed below in the context of how they can be used to help advance an agency's performance objectives and the goals of rapid renewal.

6.1 Performance Specifications and Project Delivery

As noted in Section 5.2, the delivery approach selected for a project will largely drive the extent to which an agency can allocate responsibility for performance to the contractor. As illustrated in Figure 6.1, the contractor's responsibility for the project's performance under DBB would not extend beyond the end of construction or possibly a limited (1-year) materials and workmanship warranty. In contrast, the nature of a design-build-operate-maintain (DBOM) contract will inherently expose the contractor to more performance risk as it assumes responsibility for design, construction, and the repair and rehabilitation measures that will be required over the contract's maintenance period (usually one life-cycle or longer). The degree of performance risk allocated to the contractor under design-build (DB) and warranty projects would fall between these two extremes.

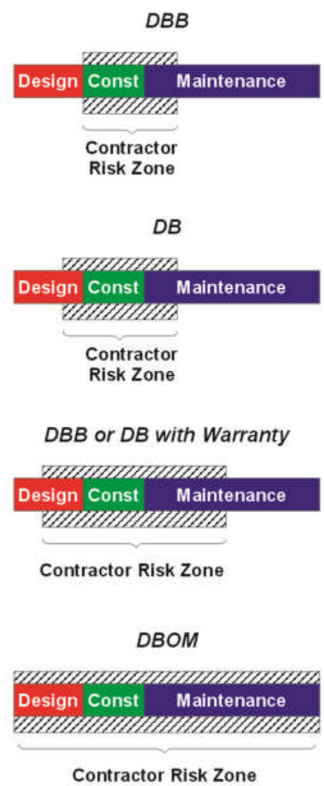

Figure 6.1: Risk Allocation & Contract Delivery

When deciding to use a performance specification, one must therefore consider how a particular delivery approach and its inherent conventions regarding design and post-construction maintenance could affect the selection of performance parameters and the setting of limits or thresholds commensurate with the degree of performance risk assumed by the contractor. For example, as discussed further below, specifying high-level performance requirements on a DBB project would be inappropriate as it would require the contractor to assume risk for items for which it has minimal control or influence.

At the other end of the project delivery spectrum, a DBOM project would primarily favor the selection of high level performance parameters that focus on user needs (e.g., safety, comfort, accessibility), as materials and construction requirements would represent unnecessary constraints on a contractor required to assume whole-life performance risk.

Other variants of the four delivery approaches discussed below (e.g., design-build-finance-operate and maintenance contracts) are not specifically addressed in these guidelines nor in the companion guide specifications. However, the parameters used to monitor and evaluate the contractor's performance in maintaining the asset over time would be comparable to those found in the DBOM case. Another project delivery approach receiving considerable attention as of late is Construction Manager at Risk (CMR). In the case of CMR, although the contractor may be able to provide some early input on design and constructability issues, the performance specifications would not be fundamentally different from those implemented under DBB.

6.1.1 Design-Bid-Build (DBB)

DBB is the traditional project delivery system through which an agency will contract with separate entities for design and construction services. Given this separation of services, a DBB project would present few opportunities for a contractor to provide input on design and constructability issues. Specifying high-level performance parameters under this approach would therefore be inappropriate, as it would require the contractor to assume risk for items for which it has minimal to no control. A performance specification implemented under the DBB approach would primarily include end-result parameters needed to address specific project goals (e.g. use of a smoothness requirement on a pavement project). The goal of such a performance specification would not be to monitor and evaluate a product's performance over time (as may be the case for a performance warranty or a specified operations and maintenance period) but to:

- Focus on material properties and construction practices deemed to have the most effect on long-term performance, and to
- Incorporate financial incentives/disincentives to promote enhanced quality or durability.

6.1.2 Design-Build (DB)

DB is a delivery system in which the agency retains a single entity to design and construct a project. In contrast to DBB delivery, a DB project would provide more opportunities for a contractor to provide input on design and constructability issues, especially if innovation is an agency goal. Several of the more prescriptive materials and construction requirements that would be included in a DBB specification could therefore be eliminated or relaxed under DB to extend more flexibility to the contractor. However, by relieving the contractor of further responsibility for facility performance at the end of construction (beyond the standard materials and workmanship warranty), the agency would still be limited to an acceptance plan based primarily on end-result properties similar to those included under the DBB approach.

In exchange for providing more design freedom and for reducing its typical inspection and testing activities to accommodate an accelerated construction schedule, the agency may tighten up the acceptable tolerances under DB to help ensure that schedule or cost considerations do not compromise quality.

6.1.3 Performance Warranties

Performance warranties are used to guarantee the integrity of a product and the contractor's responsibility to repair or replace defects for a defined post-construction period (e.g., 5 to 10 years). Warranties may be applied to both DBB and DB projects to similar effect, assuming that the agency provides sufficient latitude to the contractor with respect to the design and construction of the warranted project element(s).

A warranty will allow the agency to expand the performance measurement strategy used under DBB or DB to include functional parameters that monitor and evaluate the *actual* performance or condition of the project *over time*. The protection against defective work and premature failure offered by the warranty will allow the agency to eliminate or relax some of its standard materials and construction requirements if doing so could help save time and/or minimize disruption in the interest of rapid renewal.

Given their limited duration, short-term performance warranties primarily only protect the agency against premature failures. Although it is possible to develop a warranty provision of sufficient duration to address long-term performance, bonding issues may limit the practicality of implementing such a specification.

6.1.4 Design-Build-Operate-Maintain (DBOM)

Under DBOM a single entity designs, constructs, and operates and maintains a project for a specified duration (usually the life-cycle of the project element or longer). Note that the DBOM approach could be extended to include private sector financing as well.

The assignment of post-construction maintenance responsibility and, with that, allocation of whole-life performance risk, to the contractor allows the agency to shift its emphasis from the end-result acceptance properties relied upon under the DBB and DB methods to post-construction measurement strategies that evaluate the actual performance or condition of the facility over time.

Given the degree of performance risk assumed by the contractor, performance specifications implemented under a DBOM approach should provide contractors maximum flexibility with regard to design, construction means and methods, and the repair and rehabilitation measures that will be required over the contract period. Few, if any, materials and construction requirements should be included in the measurement strategy to avoid undermining the effectiveness of the risk transfer to the contractor.

Note that in order to motivate the contractor to provide high quality construction and to perform preventative maintenance in a timely and efficient manner, the contract term should be of sufficient duration to expose the contractor to the consequences of its actions (i.e., allow the contractor to enjoy the profits that may stem from high quality work and to suffer losses due to poor workmanship and planning). Ideally, this concept will lead not only to significant efficiency gains, but also to technological innovation.

6.2 Procurement Considerations

The traditional fixed-price, sealed bid procurement process may not always offer the best approach to selecting a contractor. Various alternatives to the traditional process are therefore discussed below in the context of how they can be used to help advance project goals. As summarized in Figure 6.2, some methods may be more appropriate than others given the level of performance requirements and delivery method selected for a project.

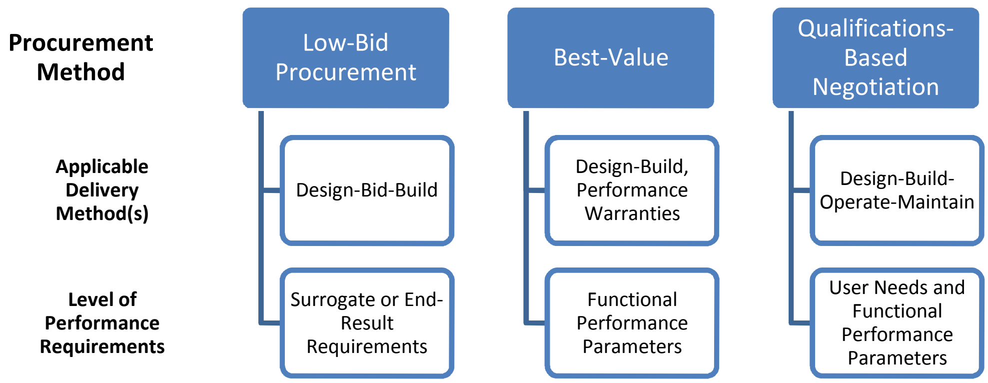

Figure 6.2: Procurement Strategies vs. Delivery Approach & Performance Requirements

To the extent possible, the procurement process should be tailored to align with the performance specifications and delivery method selected for a project. In this sense, the performance specifications, delivery method, and procurement strategy can act as complementary components of an overall performance contracting system designed to achieve a project's goals (see Figure 1.2).

6.2.1 Cost-Based Procurement Options

Traditional Low-Bid Approach. Most highway construction contracts are awarded to the contractor that submits the lowest responsive bid. This low-bid procurement approach has long-standing legal precedence, promotes open competition, and provides the lowest initial price that responsible, competitive bidders can offer. Furthermore, awarding only on the basis of price and responsiveness introduces relatively little subjectivity into the evaluation and selection process.

In general, this lowest-price-responsive-proposal approach is most appropriate for small-to-medium sized projects having a relatively standardized design and for which no innovation or time savings are sought. To help achieve performance goals, the agency could link its prequalification process to meeting certain minimum prescribed requirements related to the contractor's quality management systems, personnel, and past performance on similar projects.

However, in the interest of rapid renewal, the agency may also wish to consider factors such as the construction schedule, traffic disruption, and quality enhancements in a competitive framework. By incorporating the options discussed below into the procurement process, the agency can provide bidders with an incentive to optimize their bid prices against rapid renewal goals. For example, if construction duration is critical, Cost-Plus-Time Bidding can be used to provide the optimum tradeoff between cost and time.

Cost-Plus-Time (A+B) Bidding uses a cost parameter (A) and a time parameter (B) to determine a bid value. The cost component (A) is the traditional bid for the contract items and is the dollar amount for the work to be performed under the contract. The time component (B) is the total number of calendar days required to complete the project, as estimated by the bidder, multiplied by an agency-determined daily road user cost (RUC) to translate time into dollars: A + B(RUC) = Total Bid

The total bid value is used only to evaluate bids. The contract amount is based on the bid price (A), not the total bid value. The number of days bid (B) becomes the contract time. Note that the lowest combined bid may not necessarily result in the shortest B time. A+B bidding relies on the contractor to provide the optimal combination of cost and time.

Multi-Parameter Bidding. To incorporate the value of quality in the bidding and contractor selection process, the agency may extend the A+B bidding concept to include an additional cost parameter (C) related to quality. The total bid value is used only to evaluate the low bidder. The contract amount is based on the bid price (A), not the total bid value (A+B+C).

To incorporate a quality parameter into the bidding process, NCHRP Report 451 (Anderson and Russell 2001) suggests using the multi-parameter equation in the form of (A+B)C, where C is a quality factor used to adjust the contractor's bid based on anticipated or bid quality levels. For example, if the agency collects contractors' historical quality data, this past performance on agency projects could be used with the pay factor equation to determine the quality factor for bid evaluation. Calculating the quality factor as the inverse of the pay factor equation (1/PF) would reduce bids from contractors with high quality levels on past projects (i.e., pay factors exceeding 100 percent), while increasing bids from contractors with poor quality on past projects (i.e., pay factors less than 100 percent). This approach would thus reward contractors for higher levels of quality delivered on previous projects for the agency. Note that under this approach, the "C" quality parameter would only be used to determine the low bidder. Once the project is underway, the agency would assess the quality level actually achieved on the project for payment purposes. Alternatively, the agency could allow contractors to estimate and bid their own "C" quality value. The contractor would then be held to achieving the quality level bid, or risk receiving reduced payment. This approach could be implemented by applying a factor of C_{actual}/C_{bid} to the results of the pay factor equation. If the contractor were to exceed the quality level bid ($C_{actual}/C_{bid} > 1$), payment would be increased. If the contractor could not meet the quality level bid ($C_{actual}/C_{bid} < 1$), payment would be decreased.

Design and Bid Alternates. The multi-parameter bidding concept discussed above could also be used to evaluate alternate designs and alternate bids proposed by contractors (e.g., asphalt vs. concrete pavements; steel vs. concrete bridges). In this case, "C" would represent a life-cycle cost adjustment factor that the agency could use to help ensure that the alternate proposal would not impair the service life and maintainability of the project, in a manner similar to how value engineering proposals may be used after contract award. Alternates can be used to allow competition to drive the most cost-effective material choice or design and to shift some design responsibility to the industry, particularly if the agency is not otherwise authorized to use design-build. Potential advantages and disadvantages associated with using alternates, as well as the other cost-based procurement methods discussed in this section, are summarized in Figure 6.3.

Low-Bid

Objective:

- Obtain lowest initial price that responsible, competitive bidders can offer

Advantages:

- Established legal precedence
- Promotes open competition
- Objective evaluation and selection process

Disadvantages:

- No ability to consider factors other than cost
- Contractors may be encouraged to submit unrealistically low bids, with the assumption that cost variances can be addressed through change orders issued during construction

Cost + Time Bidding

Objective:

- Provide the optimum tradeoff between time and cost

Advantages:

- High likelihood of reducing contract time
- Minimizes time/cost impacts to traveling public
- Promotes innovative scheduling
- Encourages contractors to maximize efficiency of crews and equipment

Disadvantages:

- Contractors may sacrifice quality & safety to meet an unreasonably low time component bid to win the contract
- Bid prices and other direct project costs may be higher
- Administrative costs may be higher due to accelerated schedules that increase demands on agency personnel (though such costs may be offset by shorter construction duration)

Multi-Parameter Bidding

Objective:

- Achieve equal or better quality than specified, at optimal time and cost

Advantages:

- Encourages improved end-product quality
- Achieves multiple goals by lowering life-cycle costs while saving time
- Encourages innovative construction techniques that can improve quality and timely delivery

Disadvantages:

- Possible reduction in open competition
- Difficult to translate a level of quality into a dollar value and determine an appropriate weighting to combine with other factors
- Bid prices and other direct project costs may be higher

Design / Bid Alternates

Objective:

- Provide equal or improved performance at lower initial or life-cycle cost

Advantages:

- Allows competition between products with different maintenance and service life expectations
- Potential for lower initial costs or life-cycle costs
- Promotes innovation

Disadvantages:

- Review of alternate design submissions may be time consuming
- Difficulty in evaluating costs of alternates
- Life-cycle costing to determine low bid is difficult to determine
- Potential for bid protests

Figure 6.3: Comparison of Cost-Based Procurement Options

6.2.2 Best-Value Procurement

The cost-based methods described above have the advantage of being the most similar to the highway industry's traditional low-bid approach to procuring construction contractors. However, if the agency wishes to transfer more performance responsibility to the industry (e.g., through design-build delivery or warranty provisions), the approaches described above may not offer sufficient flexibility with regard to evaluating technical factors, such as innovation and quality enhancements, which do not readily lend themselves to a strict first-cost or life-cycle cost comparison.

Best-value procurement allows agencies to consider key technical factors, in addition to price, in the bid evaluation process to help select a capable, qualified contractor that understands the agency's performance expectations for the project. By aligning the non-price technical factors included in the solicitation documents to the project goals and performance specifications, the agency can create a more transparent (albeit still somewhat subjective) way to consider performance goals in the contractor selection process.

Evaluation System Planning. Early in the project development process, the agency personnel assigned to the project should begin to outline a plan for evaluating the proposals submitted. The evaluation and selection plan should describe the evaluation factors and their relative importance (weighting), proposal rating guidelines, and other information critical to maintaining the integrity and fairness of the selection process. Adherence to this plan will help the agency defend its selection decision in the event of a bid protest.

A key element of evaluation system planning is identifying the evaluation criteria that will be used to assess the ability of proposers to meet the needs and goals expressed in the project's performance specifications. For example, although not a complete guarantee of quality and/or innovation, the experience of consultants and subcontractors in relevant specialty areas can often serve as an indicator of the proposers' ability to successfully complete the project or a particular portion of the work. Such information could be obtained either through a Request for Qualifications (RFQ) or a prequalification process. The technical proposals submitted in response to a Request for Proposal (RFP) could then provide further indication of the proposers' understanding of the work and ability to meet the performance specifications. For example, if the performance specifications will transfer construction quality management responsibility to the contractor, the RFP could require proposers to address their general approach to quality management in their technical proposals. By evaluating and scoring these approaches, the agency could continue to exert some control over the approach used to assure quality.

The agency should begin to think about evaluation factors soon after identifying the project goals and preparing the performance specifications. Considering that project goals typically fall into the categories of time, budget, and quality, it is not surprising that evaluation factors generally follow suit, falling into the categories of schedule, price, and technical criteria. Evaluation factors may be set up on a pass/fail basis, in which the proposers have to meet certain minimum prescribed requirements to be responsive, or on a more qualitative, best-value basis, in which evaluators rate the proposals according to the evaluation criteria included in the RFP. Either way, to be effective, each criterion should be defined in terms of some measurable standard against which responsiveness can be measured.

Evaluation factors should be designed to solicit information that can support meaningful comparison and discrimination among competing proposals. When identifying these factors, the agency should consider the time and effort that proposers will have to invest in preparing responsive proposals, and that of agency personnel in evaluating this information.

Implementing a Best-Value Selection Process. Several options are available for evaluating and selecting a contractor (e.g. adjusted bid, weighted criteria, tradeoff analysis, etc.). Although all are viable approaches, the adjusted bid method is the most common approach for first time users. (Caution: Some states may have legislation specifically prohibiting the use of best-value or restricting the selection process to a specific method.)

Regardless of the exact selection mechanism used, the RFP must clearly establish and communicate a transparent process by which the agency will evaluate proposals and select the successful contractor. A general process for implementing best-value procurement is described below. For additional information, refer to NCHRP Report 561, Best-Value Procurement Methods for Highway Construction Projects (Scott et al. 2006).

A Closer Look: Implementing Best Value

The following discussion identifies the general steps involved in implementing a best-value procurement process. For further details, refer to NCHRP Report 561, Best-Value Procurement Methods for Highway Construction Projects (Scott et al. 2006).

1. Develop qualifications, technical, schedule, and cost evaluation criteria. The non-price factors and their maximum point values or weightings should align closely with the goals and the actual value that the criterion brings to the project.
2. Devise a scoring system to evaluate the proposal's responsiveness to the evaluation criteria established in the RFP. If using an adjusted bid approach, price is divided by the total score to determine the adjusted bid. If using a weighted criteria method, technical factors and price would be scored and summed to determine the total score.
3. If a two-phase selection process is used, prepare and issue an RFQ. (Otherwise, proceed to Step 7.) An RFQ constitutes the first phase of a two-phase procurement approach. The purpose of the RFQ is to narrow down the number of interested proposers to a short list of three to five qualified and capable firms who may then respond to the RFP. The short list is determined based on an evaluation of the statements of qualifications (SOQs) that prospective contractors submit in response to the RFQ.

   The RFQ is not intended to solicit specific ideas on how each firm will meet the performance specifications. Rather, an RFQ process should be used to identify firms capable of effectively delivering the project, reserving the evaluation of specific design and construction approaches for the RFP stage.

   The RFQ solicitation should include the following items, as a minimum:

   - Project description;
   - Statement of project goals and objectives;
   - Procurement schedule;
   - SOQ submittal requirements;
   - Explanation of the SOQ evaluation process, including evaluation factors and their relative importance, and the short-listing process;
   - General discussion of the RFP, to the extent this information is known at the time of RFQ issuance;
   - Other pertinent provisions (e.g., protest procedures; State and Department rights and disclaimers; and MBE/WBE/DBE and EEO requirements); and
   - Forms required for the SOQ.

4. Receive SOQs.
5. Evaluate SOQs as described in the evaluation plan and determine which are fully responsive in meeting the qualifications criteria. Criteria may be evaluated on a pass-fail basis or using a point score to determine responsiveness. While project-specific needs and goals will drive the exact technical factors included in an RFQ, typical evaluation factors address the following:

   - Proposer's understanding of the project and issues;
   - Key personnel experience and qualifications; and
   - Proposer's resources and ability to handle a project of similar size and complexity.

6. Announce the short list of fully responsive SOQs.
7. Publish the RFP for the short-listed competitors. If required qualifications were previously established through an RFQ stage, the RFP should focus on the approach proposers will take to complete the project. To the extent possible, the RFP should not reevaluate factors that were already evaluated at the RFQ/SOQ stage, unless such information has undergone significant changes in the interim. In the case of a single-phase procurement, the RFP would have to address both qualifications and the technical approach to the project.

A Closer Look: Implementing Best Value (con't)

The RFP solicitation should include the following items, as a minimum:

- Scope of work, plans, and specifications;
- Procurement schedule and process;
- Project goals and objectives;
- Required qualifications (if an RFQ step was not used);
- Proposal submittal requirements (for both the price and technical proposals);
- Explanation of the proposal evaluation process, including evaluation factors and their relative importance, the evaluation method, and the selection process;
- Method to carry forward the SOQ qualifications ranking/scores into the final evaluation;
- Other pertinent provisions (e.g., protest procedures; State and Department rights and disclaimers; and MBE/WBE/DBE and EEO requirements); and
- Proposal forms.

8. Evaluate the submitted proposals against the RFP requirements and determine which are fully responsive. The agency may require that the proposers submit separate technical and price proposals. The technical proposal will be opened first and evaluated for responsiveness, followed by scoring the responsive proposals in each technical area. The price proposals will then be opened to determine responsiveness to required pricing requirements.
9. Eliminate any non-responsive proposals.
10. Roll-up evaluation results, and determine the total point score for each responsive proposal. At this stage, the Department may issue a request for clarification to individual proposers, schedule oral presentations, or hold discussions with proposers to clarify or verify certain aspects of the proposal. The results of this communication will be factored into the evaluation.
11. Compute the final scores and select the proposer offering the best value to the agency.

For *adjusted bid*, the following formula may be used:

$AB = P/T$

Where: AB = Adjusted Bid
P = Project Price
T = Technical Score

Award to AB_{min}

For *weighted criteria*, the following formula may be used:

$TS = W_1S_1 + W_2S_2 + \ldots + W_iS_i + W_{(i+1)}PS$

Where: TS = Total Score
W_i = Weight of Factor i
S_i = Score of Factor i
PS = Price Score

Award contract to the proposer that earned highest total score. The price scores are typically normalized against the lowest price.

The adjusted score calculation is simple and easier to implement. The weighted criteria can be more complex to implement but allows greater flexibility in determining the relative importance of price versus various other evaluation criteria. For example, if innovation is a project goal, higher weights could be assigned to technical criteria than to price. Alternatively, if the agency is faced with a tight budget, price can be given the higher weight, encouraging technical approaches that will reduce costs.

6.2.3 Negotiated Procurements (for DBOM)

Given the long-term nature of most DBOM contracts, the best-value procurement process described above is often supplemented (if not supplanted by) complex financial negotiations, particularly if the private sector partner is financing part or all of the initial construction.

Typically, the agency will identify a fixed operations and maintenance term (e.g., 30 years), for which contractors will propose an annual payment schedule or cash flow curve. If construction phase services were also financed by the contractor but will not be compensated through toll revenue, the payment schedule may also include repayment of the initial construction and financing costs. [Note that in preparing its proposed payment schedule, the contractor will want to ensure that the project will provide a reasonable return on its invested capital, net of design and construction, operation and maintenance, various reserve or coverage funds, and other expenditures. A positive NPV of the net proceeds from the project would represent a viable opportunity for the contractor (as would a project for which the internal rate of return (IRR) on invested capital would exceed that which could otherwise be obtained by investing funds elsewhere.)]

The capital expenditures identified in the cash flow curve should align with expectations regarding the long-term performance of the proposer's technical approach as it relates to both the design and initial construction, and the maintenance and rehabilitation scheduled for the operations period. The likely differences in the technical approaches offered by different proposers will preclude a direct comparison of the corresponding payment curves. For example, one proposer may plan for a large initial capital investment with minimal future outlays, while another could propose a lesser design for the initial construction to be followed by a larger investment in the future.

To evaluate and compare the payment schedules offered by different proposers, one approach would be to calculate the proposed cash flow on a net present worth or value (NPV) basis to determine the proposal offering the best value to the agency. Note, however, that NPV calculations depend on assumed future inflation rates on costs and interests rates on debt. Given the time value of money, results beyond 20 years should be viewed with caution when assessing the risk associated with such projects.

6.3 Incentive Strategies

To be most effective, a performance specification should act to motivate industry to strive for excellence in performance (which for a rapid renewal project would likely entail optimizing construction efficiency and providing quality workmanship, with minimal traffic disruption). Achieving this objective often requires developing and structuring a payment mechanism that will encourage and reward superior performance with regard to the key performance parameters, while assessing penalties for noncompliance.

Considerations Regarding Pay Adjustment Strategies:

- How much is the agency willing to pay to achieve a level of performance beyond the minimum prescribed?
- Which performance parameters, if any, should be tied to incentives/disincentives?
- Does the incentive strategy align with the payment conventions associated with the chosen project delivery method?
- Have the pay adjustments been designed in a manner that will discourage distortions or behavior that run contrary to the agency's ultimate objectives?
- Are there alternatives to monetary incentives (e.g., extension of a O&M term)?

In developing a payment mechanism, a balance must be struck between value for money and effective motivation of the contractor to prevent and/or correct substandard performance. To achieve this balance, the cost of incentives must be weighed against the benefits of enhanced performance and the risks of a possible failure to the agency.

6.3.1 Quality-Related Pay Adjustment Factors

If measurements indicate that the facility does not comply with the performance requirements, the specification should describe the reconstructive work or remedial action that the contractor must perform to meet the performance requirements. If, however, the nonconformance falls within an allowable tolerance, the specification may provide the contractor the option of foregoing the repairs in return for accepting reduced payment. The required remedial action, or, alternatively, the pay adjustment, should reflect the severity of the nonconformance.

Application of quality- or performance-related pay adjustment systems is generally more evolved and prevalent for pavements than for other highway discipline areas, such as bridges and earthwork. Nevertheless, even for pavements, no universally accepted method for calculating quality-related pay factors has been established. As discussed further in Volume II, Chapter 2 of these Guidelines, one approach proposed for use in highway construction entails development of performance-related specifications (PRS) in which mathematical models are used to perform a life-cycle cost (LCC) analysis of the as-constructed facility. More common, however, are statistically-based sampling and testing plans that consider the measured variability of the product to determine pay factors.

6.3.2 Time and Other Performance-Related Incentives

Aside from such quality adjustments, incentives can also be used to help achieve other rapid renewal goals, such as accelerated completion and reduced disruption, as well as goals established for environmental compliance, public relations, and public and worker safety.

In developing incentive amounts, the agency should keep in mind that the rate should be attractive enough to entice the contractor to achieve the desired result. The determination of this amount is rarely an exact calculation, and judgment is often necessary, particularly for areas having less tangible, or less quantifiable, benefits, such as improved public relations and environmental compliance. Incentive payments for other areas, such as early completion and safety, have more established (albeit still somewhat subjective) calculation techniques. For example, road user costs typically factor heavily in the determination of an incentive program for early completion. Similarly, user costs can also be used to generate incentives related to maintenance and protection of traffic, particularly if road or lane closures are contemplated. Safety incentive fees are generally related to reduced accident costs, with appropriate indices and indicators of impacts available from the insurance industry.

6.3.3 Pay Adjustments and Contract Delivery

The payment conventions and risk allocation inherent to various project delivery approaches will also have a large bearing on the structure of any incentive strategies used to influence contractor behavior. For example, the unit-price basis of DBB contracts makes them particularly well-suited to pay factor adjustments of the type described above to address end-of-construction quality. Conversely, the post-construction responsibilities included in a DBOM contract should largely eliminate the need to apply such adjustments at the end of the initial construction phase. However, such contracts may include complex penalty/reward systems to address the post-construction operation and maintenance of the facility.

DBB and DB. DBB projects are generally bid and measured on a unit-price basis, which makes the application of pay factors, developed using either predictive models or statistically-based acceptance procedures, relatively straightforward.

In contrast, DB contracts are typically awarded on a lump-sum basis, making them less amenable to pay factor adjustments tied to quantities and unit prices. Therefore, to apply a similar pay adjustment process to a DB contract, the agency may wish to require in the RFP that proposers submit a breakdown of quantities and unit prices for each work item subject to pay adjustment. During the construction phase, the agency would then also monitor and measure the associated material quantities, just as they would on a DBB project.

Warranties. It is generally not necessary or advisable for warranty projects to include quality-based pay adjustments or incentives for certain construction acceptance criteria, such as initial pavement smoothness, if the agency will be monitoring these criteria during the warranty period. However, an agency may decide to apply pay factors to end-of-construction acceptance properties that would not otherwise be addressed as part of the warranty evaluations.

DBOM. The payment terms found in DBOM agreements tend to be more complex than other contract types, particularly if the contractor finances certain front-end costs of the project (e.g., planning, design, construction, etc.), which are to be recouped as part of toll revenue or periodic payments received from the agency during the operation and maintenance phase of the agreement. However, even without a private financing component, the payment mechanism used under DBOM is critical to the successful transfer of whole-life performance risk to the contractor.

To ensure the contractor's motivations remain aligned with the project goals, the performance requirements and associated payment mechanisms should be structured in a manner that will provide clear economic incentive to the contractor to perform to the required standards and prevent and correct service failures. This can be accomplished through a system of monetary deductions for non-compliance (or bonuses for superior performance) and assessment of lane rental fees (or similar) for taking lanes out of service.

For example, during the operation and maintenance phase of a DBOM project, the contractor will typically receive a periodic payment (sometimes referred to as an *availability* payment) on a monthly or some other basis related to its maintenance obligations. In order to be entitled to the full payment, the contractor must ensure that the facility complies with the specified performance requirements. The payment will remain the same as long as the required performance levels are met. It is therefore possible that during some months the contractor will have to carry out a large amount of physical works in order to meet the required performance levels and very little work during other months. If the agency's goal is receive high initial construction quality, the pay adjustment system could be used to make it cost-prohibitive for the contractor to provide poor initial quality at the risk of incurring penalties and lane rental fees to correct service failures during operation.

Perhaps the simplest way to account for performance deficiencies is to apply a straight monetary deduction to the contractor's periodic payment. Alternatively, a two-step process could be used, in which the contractor would incur a specified number of penalty points for each failure, with the accrued points then translated to a monetary deduction. In this case, deductions may not start until a threshold number of points are exceeded. Under either approach, if performance deteriorates below a certain level, other non-financial means can be implemented to compel the contractor to improve performance, ranging from increased oversight to termination for breach of contract.

To establish an appropriate magnitude for the payment adjustments (and/or penalty points), consider the following factors:

- Importance of a particular parameter to the agency
- Extent to which the safety of the public is compromised
- Incidence and persistence of a particular non-compliance item

In addition to not meeting quality-based performance targets, adjustments may be made for the contractor's failure to respond to performance deficiencies in the prescribed timeframe. Positive adjustments could also be made to account for greater than expected usage of the facility by heavy vehicles, given their disproportionate effect on service life.

Similar to warranties, the contractor's post-construction responsibilities should eliminate the need for quality-based pay adjustments at the end of the initial construction phase. However, if timely construction completion is an issue, the agency may choose to apply incentives or disincentives to the completion of the initial construction phase of the contract. Alternatively, the structure of the payment terms for the maintenance phase of contract may also be used to inherently reward or penalize the contractor for early or late completion. By not beginning the scheduled periodic payments until after issuance of a construction completion certificate, and not adjusting the overall contract period (i.e., construction plus maintenance phase) as a result of the early or late completion of the initial construction phase, the contract would in effect impose a penalty for late completion and a corresponding bonus for early completion.

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