



SHRP2 Peer-to-Peer Technical Exchange Developing Performance Specifications Burlington, Vermont

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AASHTO

Agenda – Developing Performance Specifications

- Agency Barriers to Specification Development – RD&LG
- Pyramid for Performance Specifications - RD
- User and Societal Needs and Goals - RD
- Using Users Needs and Goals to Performance Parameters - LG
- Project Delivery Approaches - LG
- Appropriate Measurement Strategies - RD
- Incentive Strategies and Payment Mechanisms - RD
- Identify Gaps - LG
- Identify and Evaluate Risks when using Performance Specifications - LG
- Development of Specification Language- LG
- SHRP2 Examples of Performance Specifications – LG&RD

SHRP2 R07 Products

1. Performance Specifications for Rapid Highway Renewal. SHRP 2 R07 – RR1
2. Strategies for Implementing Performance Specifications: A Guide for Executives and Project Managers. SHRP 2 R07 – RR2
3. Framework for Performance Specifications: Guide for Specification Writers performance specifications. SHRP 2 R07 – RR3



FHWA 2004 Performance Specifications Strategic Roadmap

- 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 as determine how best to deliver that product.**
- Freedom to innovate with accountability to deliver is the driving force behind the performance specification movement (FHWA 2004).

Agency Barriers to Specification Development

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

Goals and Objectives Chapter 2

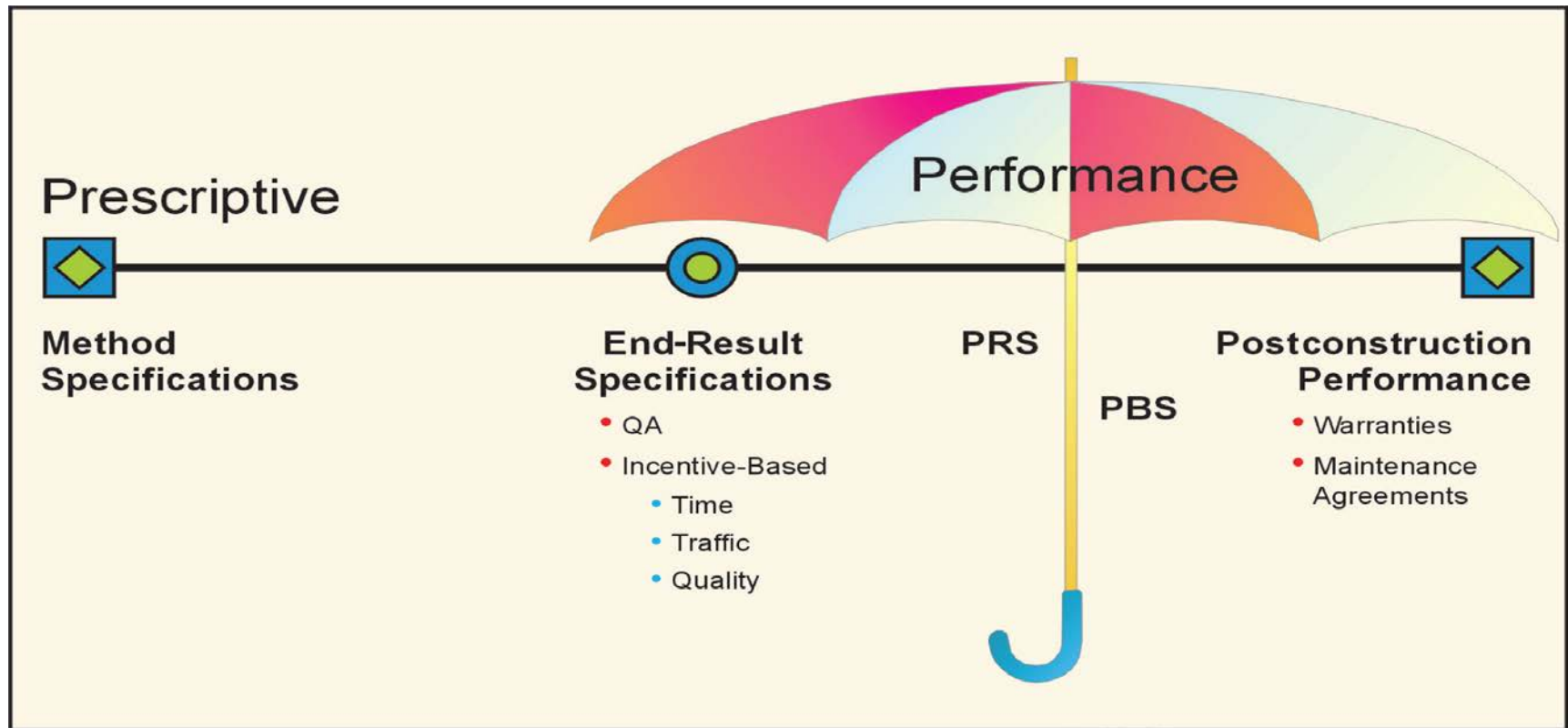
- **How performance specifications can be developed to achieve a project's needs and goals and**
- **How to establish a performance measurement strategy, including**
 - The role project delivery can play in selecting performance parameters
 - Changes in roles and responsibilities related to quality management
 - Potential gaps and risk mitigation
 - How to structure a payment mechanism to motivate contractor performance.

Performance Specification Continuum

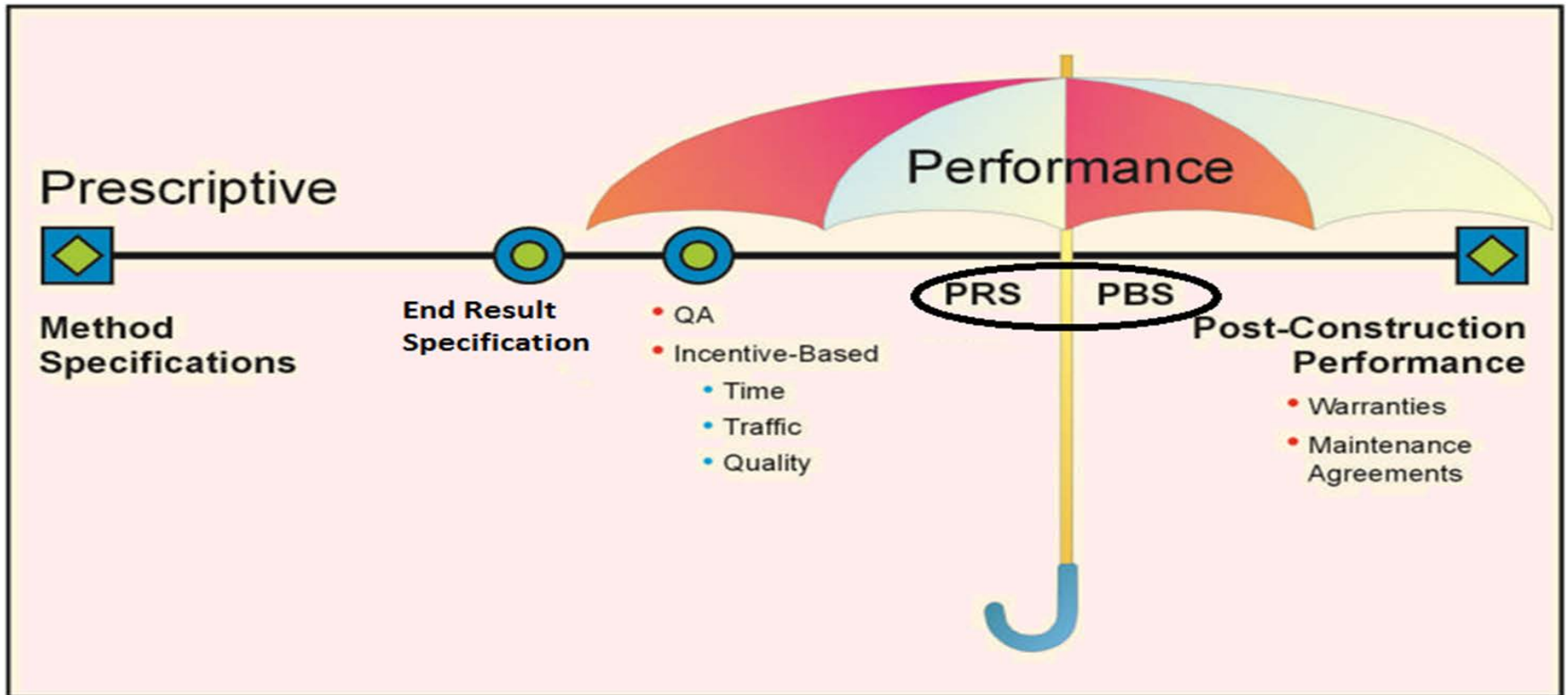


- In general, these specification types represent a **progression** toward increased use of higher-level acceptance parameters that are more indicative of how the finished product will perform over time.
- To varying degrees, they all attempt to **shift performance risk to the contractor** in exchange 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 improve the quality or economy**, or both, of the end product.

Agency Barriers to Specification Development – SHRP 2 R07

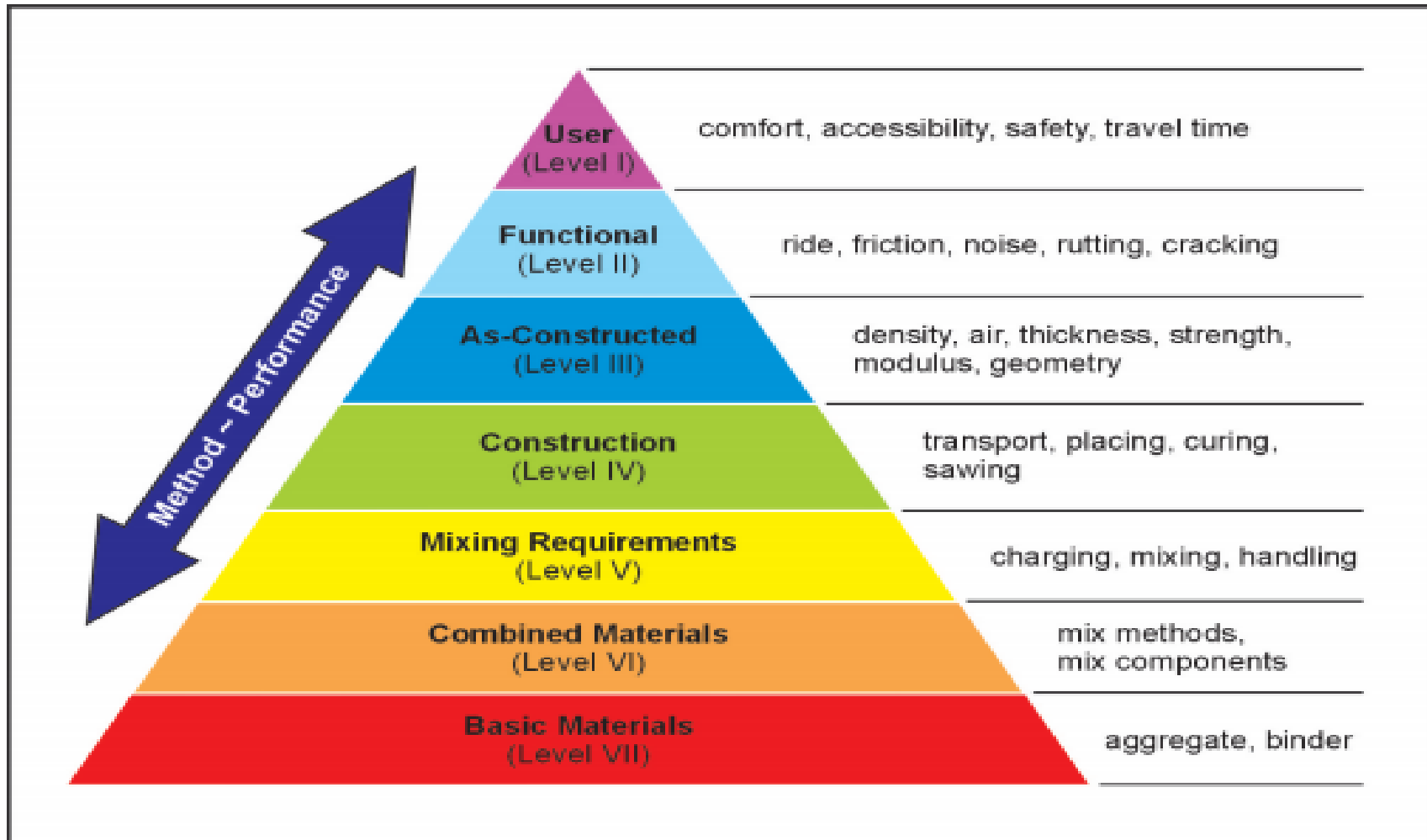


Agency Barriers to Specification Development - FHWA



Pyramid of Performance

- Performance specifications are built from the top of the pyramid down, to shift the emphasis from materials and methods to desired



Step 1: Identify User and Needs and Goals

- **What goals and needs are we trying to satisfy? That question inherently has the customer or end user in mind.**
 - For example, road users and communities may want an accessible road that offers a safe, comfortable, and quiet ride with minimal delays and inconvenience caused by construction. Performance specifications can be used to motivate the contractor to develop solutions capable of meeting those expectations.
 - What goals do you need for Asphalt Pavements?

Step 2: User needs and goals to Performance Parameters

First Define User Needs:

Safety – safety for the public in both the periods including during construction and after construction.

Mobility – addressing the traffic needs for the facility in the first place is one of the basic needs of the agency.

Comfort - Not normally considered, but knowing that if we complete the facility with smoothness in mind, we get a longer performance which equates to comfort for the users.

Users Needs – Eight Steps

- Step 2.1 Identify Users needs and goals of the agency . Are the needs and goals measureable?
- Step 2.2 If you cannot measure them directly, you need to repeat the development process in developing them in the first place. Far too many time, agencies just do what they have already done in the past.
- Step 2.3 Consider project delivery processes. DB, Warranty, P3, etc. What has the Agency used in the past that works? Involve construction, materials, research, planning, etc., together to support the goals of the project or system. One of the big question are relates to responsibilities. Level of responsibility for the contract, contractor vs agency.
- Step 2.4 Establish quantitative measurement strategies for each of the agency goals. This step tends to be skipped, but its really, important.

Users Needs – Eight Steps

- Step 2.5 Develop incentive strategies/ payment mechanisms to motivate contractors performance considering on the agency comfort zones. Statistical specifications are recommended to be fairer to the agency and the contractor.
- Step 2.6 Biggie----- Gaps. Where are your gaps in the processes of measurement. Don't forget 23 CFR 637. Agencies have basic responsibilities meeting the goals of the project, with the public funds.
- IF you have gaps, you need to may need to mix prescriptive, end-result, with PS specifications. We know that there are times and places for alternative specifications and its fine to mix and match to meet the needs and goals of the agency.

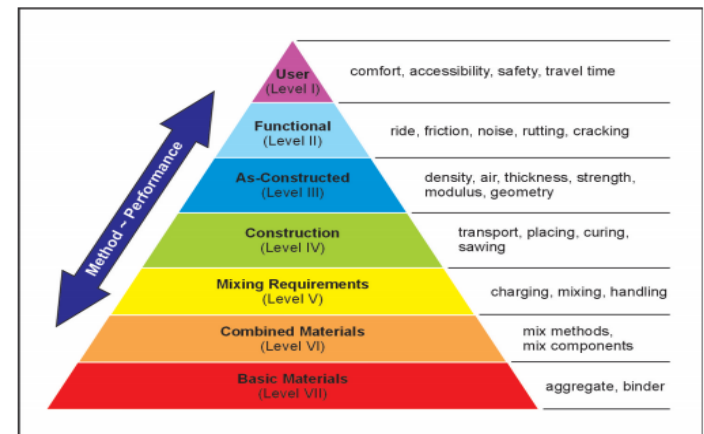
Users Needs – Eight Steps

Step 2.6 GAPS continued, a re-review of the Pyramid of Performance is appropriate to ensure that all gaps are addressed.

Step 2.7 Risk. This is where most agencies have a hard time addressing. Risk to agency and risk to the contractor has to be addressed. 0-100, 50-50, 90-10, has to be openly addressed. There is not a magic number for formula.

Each risk has to be evaluated associated with the needs and goals of the agency along the lines of development and implementation of performance Specifications.

Is the resulting risk manageable? Contractors and Agency



Users Needs – Eight Steps

- Step 2.8: Development of specifications. Far too many times agencies tend to leap towards the final step and start developing the specifications before completing analysis. This is crucial step and all specification preparers know the problems with jumping the gun.
- New testing and acceptance boundaries needs to be used.
 - The preferred language for specifications is the active voice.
 - You need to include all the functional parameters you established in the needs and goal steps.
 - Instruct the contractor in words what you want and not what you don't want. Stating it in a clear manner in short sentences is paramount.



Step 3: Various Project Delivery Approaches

- Performance specifications delivery approaches is different that the “normal” approaches, but similar.
- Definitions of Performance Specifications are critical Knowing that:
 - Design-Bid-Build & Design Build approaches are special Performance Specifications that introduces a greater roles and responsibilities for the contractors. Depending on your agency statues, you may or may not be allowed to do this. Both types have very stringent responsibility limits.
 - Warranties: Again roles and responsibilities need to be clearly defined along with the desired level of performance. The process is more of an end-result goal, but the period is not at the time construction is completed its 5-10 years down the line. This process does protect agencies against premature failures, and the carrot of future performance

Step 3: Various Project Delivery Approaches

- Definitions of Performance Based or Related specifications
 - Performance Based is based on the **desired levels of fundamental engineering properties (e.g., resilient modulus, creep properties, and fatigue properties)** . Not really a factor yet.
 - Performance Related is based on the **key materials and construction quality characteristics that have been found to correlate with fundamental engineering properties that predict performance.** Available today.
- Determine the most practical method of monitoring the operations, measuring the key quality characteristics, and pay for the work completed.
- It is satisfactory to take steps towards Performance Specifications without all the answers. You don't need to eat the elephant all in one bite. But be careful in the specification language.

Step 4: Appropriate Measurements Strategies for Performance Specs

- **Develop a Quantitative measurement strategy to evaluate the contractor's performance against the goals and parameters identified in Steps 1 and 2.**
 - What gets measured (i.e., parameters and performance measures);
 - The manner through which compliance will be determined (e.g., tests, inspections, audits);
 - Sampling plan (sample size, lot size, sample location, frequency, etc.);
 - How the test results will be used (e.g., process control, screening test, pay determination);
 - Who will perform the testing (agency or contractor);
 - Allowable deviation from the performance standard; and
 - Consequences for failing to meet the required performance level.
- **Historical data from the agency's asset management system will provide a reliable source of information to support the decision process.**

Step 4: Appropriate Measurements Strategies for Performance Specs

- **Finalize Selection of Performance Parameters**
 - Nonessential requirements can hinder contractor innovation, add unnecessary complexity to the measurement strategy, require additional testing resources, conflict with the project delivery approach, or otherwise force the agency to continue to retain the bulk of the performance risk
 - Best practice suggests limiting acceptance parameters to those that
 - Focus on key project or program objectives;
 - Relate to actions within the contractor's control; and
 - Indicate poor or improper workmanship and/or long-term durability.
- **Rapid Renewal Considerations**
 - Can measurement and testing be done in a
 - manner that has minimal impact on traffic and lane closure?
 - Can the data be collected and processed in a timely manner?
 - Are nondestructive testing techniques available?

Step 4: Appropriate Measurements Strategies for Performance Specs

- **Establish a Sampling Plan**
- **Determine Measurement Frequency**
- **Decide What Performance Measure to Use**
 - In the past, statistical averaging was often used as a basis for acceptance; however, use of the average alone fails to address product variability, which can also be an important indicator of performance.
 - percent within limits (PWL), should be used instead of the average or average deviation from a target value. Unlike other measures, PWL (or, alternatively, percent defective) captures both the mean and standard deviation (center and spread) in one measure, encouraging uniformity while minimizing opportunities for process manipulation.
- **Set Performance Limits and Thresholds**
 - A key resource for determining the appropriate values is therefore historical data gathered through past projects and the agency's asset management system. If historical data are consistent and reliable, an agency can establish a baseline of performance through a statistical analysis of data from similar projects

Step 4: Appropriate Measurements Strategies for Performance Specs

- **Set Performance Limits and Thresholds, continued**

- Absent such historical data, performance limits can be developed through
 - Research and review of common industry standards and measures from other agencies;
 - Collaboration with industry and subject matter experts;
 - Use of demonstration projects or test strips/pads at the project level; and
 - Engineering judgment and analysis (predictive models).

- **Assign Quality Management Responsibilities**

- 23 CFR 637
- A comprehensive construction quality assurance “Materials” program should consist of the following core elements: quality control, acceptance, independent assurance, dispute resolution, personnel qualification, and laboratory accreditation/qualification.
- Construction Inspection

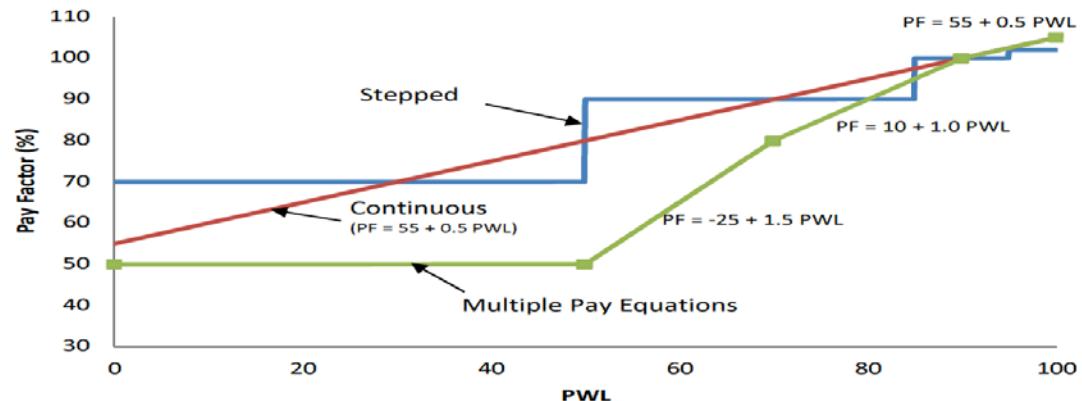
Step 5: Incentive Strategies and Payment Mechanisms for Performance

- **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 discourages distortions or behavior that runs contrary to the agency's ultimate objectives?
- Are there alternatives to monetary incentives (e.g., extension of an operations and maintenance term)?

Step 5: Incentive Strategies and Payment Mechanisms for Performance

- **Performance-Related Specifications**
- **Statistically Based Pay Adjustment Systems**
- **Types of Payment Schedules**
 - The earliest pay adjustments were based on tables or stepped schedules, which often led to disputes over rounding errors and measurement precision when the quality level of the work happened to fall just on one side or the other of a large step in the schedule. To avoid this problem, many agencies now use continuous (equation-type) payment schedules that provide a smooth progression of payment as the quality level varies. A continuous pay equation is recommended in AASHTO R 9



Step 5: Incentive Strategies and Payment Mechanisms for Perf Specs

- ***Composite Pay Factors***
- ***Operating Characteristic and Expected Pay Curves***
 - If structured properly, the plan will result in paying an appropriate amount (on average, 100% of the contract price) for work that is at or near the target performance level and, similarly, rejecting or paying a reduced amount for work that is at or below the rejectable quality level.
 - Two risks are associated with acceptance and payment plans: the seller's risk (a) (i.e., the risk to the contractor of having acceptable quality level material or workmanship rejected) and the buyer's risk (b) (i.e., the risk to the agency of accepting rejectable quality level material or workmanship).
- ***Pay Adjustments and Contract Delivery***
 - DBB, DB, and CM/GC
 - Warranties
 - DBOM

Step 5: Incentive Strategies and Payment Mechanisms for Perf Specs

- ***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; and
 - Incidence and persistence of a particular noncompliance item.
 - LCCA

Step 6: Identification of Gaps Related to Performance Specifications

The existence of major gaps may limit agencies to develop performance specifications, but again, you don't have to eat the elephant all in one bite.

For example: In developing specifications for soil project, we typically utilize moisture and density (compaction) as surrogates properties for performance of the grade. We know its not "the" complete answer but attempts to advance the rolling operations are benefitting in the performance, such as intelligent compaction.

The absence of surrogate measures, a gap may have a wider effect for example if a goal is to reduce the concrete pavement noise. We know that the pavement its self cannot effect the noise, it's the texture being placed on the pavement together with the public's vehicles which all varies.

Step 7: Identify and Evaluate Risks Related to Performance Specifications

- Technology Gaps Considerations
 - Can a desired parameter be measured and evaluated using existing Technology?
 - Are Standardized test available or do we need something new?
 - Are the test repeatable between technicians and labs?
 - Are “referee” test also available?
 - Is the approach quantitative, if not can the subjectivity of the qualitative measure be reduced? Do the alternative require both parties to reach an agreement “before construction”?

Step 7: Identify and Evaluate Risks Related to Performance Specification

- Sampling and Testing gaps
 - Can the data be collected, processed, and analyzed in a timely manner? If for QC operations can it influence subsequent operations
 - Does sampling and testing affect traffic (public) through lane closures?
 - Compared with other testing techniques, are measurement processes and testing economical? Is it a major capital investment for both the agency and the contractor?
 - Is the measurement and testing protocols practical and capable of being conducted by agency and contractor certified technicians. If so, where do they get there certification's?
 - Is sampling base on Statistics or continuous coverage.

Step 7: Identify and Evaluate Risks Related to Performance Specifications

- Knowledge Gaps:
 - Are the main factors affecting performance based on a single parameter known by all and understood by all.
 - Would a typical contractor (meaning not specialized) be able to meet the requirements in the specifications
 - Is there sufficient experience or historical data to properly calibrate the design or predictive models that addresses the performance of the operations? Is additional research required.

Step 8: Development of Specification Language for Performance Spec

- To adequately communicate a projects needs and goals, the specifications needs to address the following?
 - What is the level of performance? Agencies must acknowledge what they want.
 - How will the agency evaluate and/or monitor contractors compliance against the requirements in the specifications? Considerations for Warranty projects may be different.
 - What are the consequences for failing to meet the required performance levels and/or incentives for exceeding the minimum standards.

SHRP2 Examples of Performance Specifications

- In progress
 - HMA, PCCP, CP, etc. successes to follow
 - SHRP2 Publications

Conclusions for Developing Performance Specifications



1. Understand what you (agency) wants. “Needs & Goals”
2. Work with your partners
3. Establish or open up lines of communication with contractors.
4. Do your own research
5. Ask for help
6. Examples do exist of successes
7. Accept that more work is needed in PS concepts
8. Don't try to eat the elephant in one bite.

Thank You



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