Developing New Business and Operational Guidance Ensuring Timely and Quality Highway Performance Monitoring System Data Submittal from State Highway Agencies

DTFH61-13-D-00015
FHWA Office of Policy and Governmental Affairs

Task 4 and Task 5 Reports:
Efficient Business Processes for Data Collection and Reporting and Self-Certifying Business Model Checklist

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Table of Contents

List of Figures

List of Tables

4. HPMS Business Process Checklist

4.1 Introduction

The FHWA Business Process and Data Quality Checklist report is a resource for state Departments of Transportation to improve the quality and timeliness of HPMS submittals. The checklist will help agencies implement strategies to marshal internal resources and work with Federal-aid partners effectively and efficiently. The checklist is part of a larger effort that has:

- Recruited and worked with HPMS coordinators (an expert panel), who submit the HPMS to FHWA and coordinate with Federal partners, to understand their management structures, coordination approaches and uses of technology to create the HPMS (Task 2).

- Developed an exemplary practices manual with topics such as management structure, resource allocation, organizational layout, scheduling and other relevant aspects (Task 3).

This report contains the following:

- Chapter 4 (Task 4) describes the uses of HPMS; describes best practice "take-aways" from HPMS coordinators regarding management processes; introduces the maturity model concept to developing HPMS business practices and provides a self-scoring questionnaire (checklist) for developing an efficient, logical and practical HPMS business process.

- Chapter 5 (Task 5) provides a self-certifying questionnaire (checklist) for HPMS data collection and use from a business and management standpoint.

Each section appears in turn below.

4.1 Background

Each year, state departments of transportation (State DOTs) assemble data about the extent, condition and performance of all public roads including the Federal-aid highway system in their state and provide that data to the Federal Highway Administration (FHWA). Together, the individual state contributions create the most comprehensive national source of highway data: The Highway Performance Monitoring System (HPMS). The HPMS informs highway apportionments and provides critical information for assessing future highway infrastructure and funding needs. It has become a principle source of information to implement several of the highway performance provisions called

for in Federal transportation legislation. In short, national policy-making relies on the HPMS submittals to be timely and accurate.

The challenge of creating the HPMS revolves around what it is designed for and how it is created. First, the HPMS serves Federal policy-making and oversight needs rather than directly serving state needs. While state departments of transportation collect, analyze and deploy much of the data contained in HPMS to make operational, managerial and capital improvement decisions, most do not use the HPMS directly as part of their own business process although it is ultimately the state's data. From a state's perspective, it is only indirectly related to serving the traveling public and thus not always highly visible in state DOTs. Second, assembling and reporting the HPMS requires the coordination of multiple disciplines, and often divisions, that may not otherwise work together and that may have different mission emphases. The HPMS coordinator plays a central role in confronting these challenges to create an official data record of the state's highway system for the Federal government.

An additional challenge for agencies is creating a reasonable snapshot of the highway system's condition and performance when the data that describe it are updated frequently and in some cases, constantly. Transportation agencies are often challenged to construct a composite representation of a prior year's conditions from data collected at different points in time, and so they need a way of saving and retrieving data that may no longer be suitable for current maintenance and operational needs.

The HPMS coordinator, as the individual in charge of HPMS submittals at the state agency, organizes the work groups and the data that are needed for the annual submittal, and is the direct point of contact with FHWA. (**Figure 4.1**) The coordinator relies on technical experts, and on their data systems, in pavement, traffic, roadway inventory, planning, GIS and other disciplines to create the HPMS submittal. Each of these technical areas has unique data collection and analytical methods and tools, and each operates on a calendar that is suited to different business needs. In many states, the coordinator must work with engineers and planners across multiple engineering districts. Most work with local and regional government agencies as well.

Figure 4.1. HPMS Coordination Points

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This project has developed a checklist intended to help HPMS coordinators and contributors evaluate the efficacy and efficiency of the HPMS business process, how the team organizes itself to create the HPMS. More specifically, the goal of this checklist is to help agencies create, maintain and sustain an HPMS creation process that is:

- ▪ Efficient: a process that can be replicated with as little effort as possible.

- Logical: Each activity in the sequence supports the ones that follow. Lines of communication and management are clear and direct, with few or no duplication of effort.

- Practical: The process is streamlined, not excessively complicated, and achievable with the resources available.

To highlight the importance of establishing best-practices for HPMS business process, the statistics of the state DOT HPMS submittals can be reviewed. (**Figure 4.2**) According to the information obtained from FHWA, in 2015:

- Thirty-eight (38) states submitted the HPMS by the deadline of June 15th,

- FHWA accepted 22 of the 38 on-time submittals on the first submittal, and

- Twenty-three (23) states submitted the HPMS more than one time before acceptance.

38
Number of States that submitted the HPMS data by June 1st deadline in 2015.

22
Out of 38 on-time submittal were accepted by FHWA in 2015.

23
Number of States that submitted the HPSM data more than once in 2015 before acceptance.
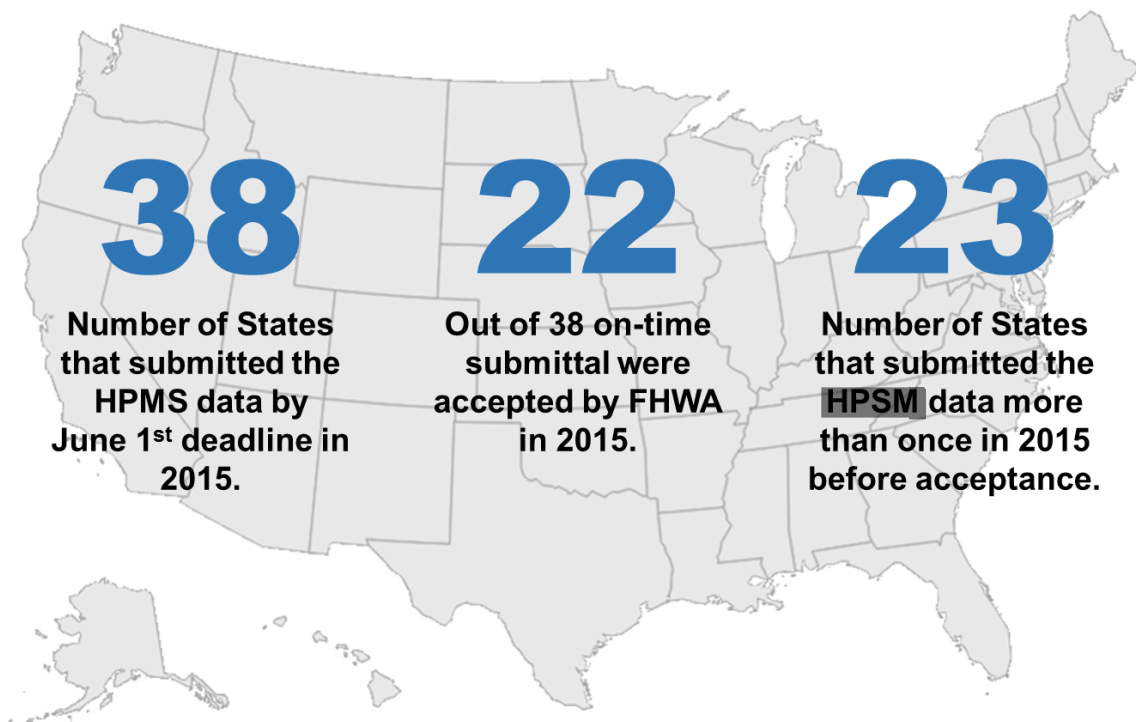
Figure 4.2. 2015 HPMS Submission Statistics

The need for timely and accurate submittals has become more acute, as the HPMS has become a principal tool for national performance management. The deadlines for a portion of the submittals has moved up in the calendar year and FHWA soon will have less flexibility than previously to accept multiple and late submittals. FHWA officials have organized their activities around an expectation that the national database will be "frozen" by April16th for Interstate, June 16th for the NHS with data extraction for the annual performance assessments on June16th and August 16th, respectively. The current deadlines are displayed in **Figure 4.3**.
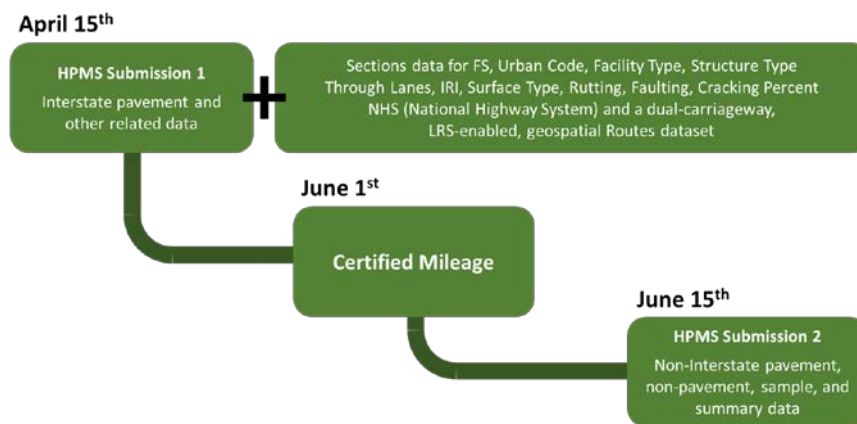
Figure 4.3. HPMS Submittal Schedule

4.2   Expert Study Panel Outreach

Working with the Office of Highway Policy Information (OHPI) nine states that have a history of providing timely and accurate HPMS information were identified (**Figure 4.4**) to serve on the Study Panel (Task 2 of this project). These nine states represent diversity in terms of urban/rural mix, size of highway system, organizational make up and other factors based on the input from FHWA and the study team.
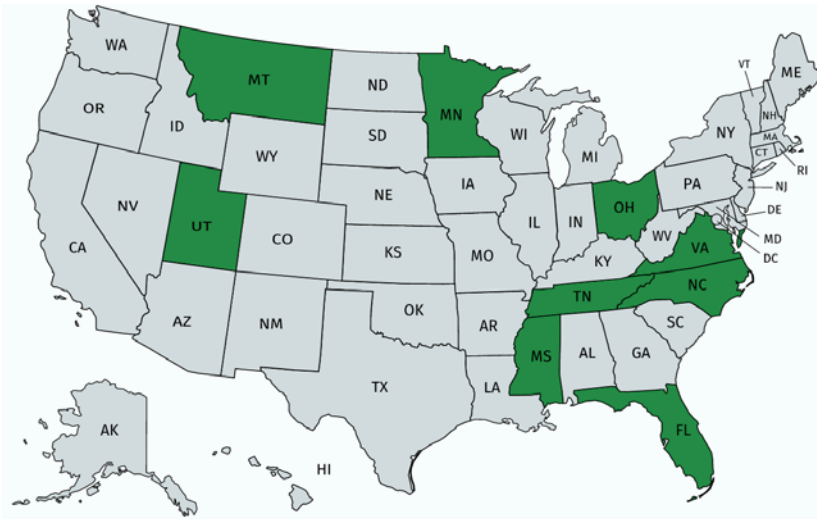
Figure 4.4. HPMS Operational Guidance Project: Expert Study Panel States

The business model checklist that is developed as part of this project is the product of numerous conversations with the HPMS coordinators of these nine states who volunteered to share information about how they organize themselves to create the HPMS each year. To understand these states' approaches to developing the HPMS, the project team organized a series of conference calls with the coordinators and the technical specialists they work with, in the summer and fall of 2016. In April 2017, FHWA hosted the coordinators at the FHWA headquarters in Washington, D.C. to confirm the states' views on successful business practices, and on the topics they agreed would be most useful for a business process checklist. The participating states have differences in their approach to submittals, organizational structures, transportation systems, and how they collect and manage data. However, they have mostly succeeded in being timely and accurate with their submittals and offered useful insights about practices that they have established and follow consistently.

Multiple topics were discussed with the state HPMS coordinators at the meeting about HPMS business model and best practices. **Appendix A** provides a summary of these topics.

4.3 Lessons Learned, Summary of the Expert Study Panel Discussions

Timely and accurate HPMS submittals are the product of an elaborate choreography of data gathering and analysis, and the coordination and cooperation of many individuals. The expert study panel talked about the conditions and factors that contribute to a successful HPMS submittal. Below is a summary of these discussions and lessons learned.

Developing the HPMS is a year-round effort. States that consistently submit on time and with high-quality data establish year-round processes. For approximately six months from July to December, the agencies collect data either specifically for HPMS or for state databases from which HPMS data are drawn. Then, from late in each calendar year until the submittal deadlines (April 15th and June 1st), data are scrubbed, re-gathered, validated, and then uploaded into the national HPMS software. Soon after submission, the HPMS team members confer, troubleshoot the year's process, and identify opportunities for improvement.

Developing the HPMS as a complex, continuous function requiring project-management strategies. The HPMS is as much a project management challenge as it is a data management challenge. Successful agencies form teams with a shared understanding of the importance of the HPMS. Each member commits to meeting deliverables according to a shared schedule. The HPMS "mission" has clear objectives, and is the product of continuous coordination to identify and address needs and issues quickly and efficiently.

There is a commitment to timely, high-quality submittals. While the organizational structures of state DOTs may differ significantly from one state to the next, successful HPMS teams share a sense of mission and commitment in their approach to submitting the HPMS. Staff express a sense of pride and commitment to the HPMS process. They stressed that a commitment to producing a quality submittal that was on-time and resulted in a successful upload of data to the FHWA HPMS application.

There is strong coordination across divisions. Although the means and scope of coordination may vary depending on the size of the agency, successful agencies demonstrate an ability to demonstrated coordinate processes that across crossed "silos." This is critical because HPMS submittals draw from numerous databases as well as from the agency's LRS.

Adequate staff also was apparent. Although the scale of the HPMS staff effort varied, each successful agency identified staff who dedicated a portion of their time each month to working on HPMS. In no successful agency was HPMS assigned to one or two isolated staff. Instead, the successful agencies had several staff from different work units such as planning, traffic, pavement management, and mapping dedicating their time to HPMS.

Successful agencies have good data and good systems. Timely and accurate HPMS submittals are symptomatic of a successful performance management process. Successful agencies have a robust LRS, reliable data-collection cycles, and data-analysis tools. The inverse may be that states that struggle with HPMS will also struggle with performance reporting.

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Clear schedules and roles also were apparent. In the agencies interviewed, the HPMS participants all were clear in their roles, what data and functions they provided, and the annual schedule and milestones they must meet. For large agencies, this clarity was provided by formal business rules. In smaller agencies, clarity came from a close-knit group working together to track the schedule. Regardless of the process, the successful states demonstrated an annual, anticipatory process to meet interim and final milestones.

> **Institutionalizing HPMS**
>
> "Motivation for success comes from within. Your good staff will do well regardless. We have been doing this for so long that everybody understands the importance of HPMS and everybody follows the schedule."
>
> *-A State DOT HPMS Coordinator*

A single person or unit organizes the process and tracks progress. Successful agencies employ at least one capable person with the span of control to coordinate all the participants. This coordinator kept in touch with groups such as the traffic, safety, and pavements team to ensure that interim data submittals occurred on time so that data would be available for testing and final upload to HPMS.

There is a culture of continuous improvement. Successful agencies review the previous year's effort and look at ways to improve all aspects, from coordination to data analysis to scheduling. Several agencies described how prior year submittal issues led to technology or process improvements. Some developed in-house software to help them gather, synthesize, and validate data. Others amended traffic counting or pavement monitoring processes to better align with the HPMS schedule and data requirements. All described a willingness to assess successes and problems and to continuously refine and improve the HPMS process.

Upper management supports the HPMS development process. In successful agencies, department chiefs support HPMS coordinators and the staff they work with, by providing adequate resources and direct management support when needed. The HPMS coordinators who are able to elevate a management or resource issue when the need arises, is much better equipped to succeed in their role. They will have the tools and technology they need. The staff they work with understands that management considers the HPMS an important product for the agency.

4.4   Best Practice Factors

Through discussions with the HPMS coordinators, factors that clearly contribute emerged. These factors, listed below and illustrated in **Figure 4.5**, have established the basis for the business model checklist.

- HPMS Coordinators Roles, Responsibilities, and Authority

- Timing and Scheduling

- Documentation of HPMS Practices and Conflict Resolution

- Management and Coordination with both Internal and External Parties

- Quality Assurance, Quality Checks, and Validation

- Institutionalizing HPMS
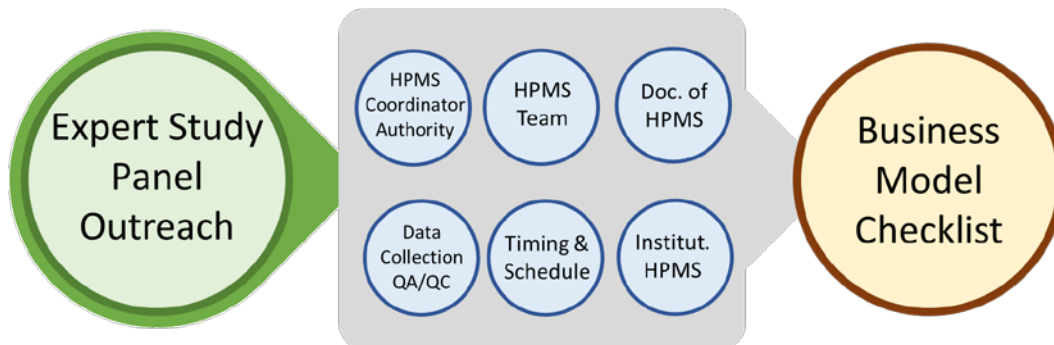
Figure 4.5. Findings of the Expert Study Panel Outreach

What these success factors mean and why they are important is to the study panel is summarized below.

HPMS Coordinator Roles, Responsibilities, and Authority

The HPMS coordinator role is complex because it requires the organizational and communications skill of a manager, and an ability to understand the technical requirements of the HPMS. From these discussions and the experience of FHWA with many coordinators over the years, the picture of what it takes to be a good coordinator that emerges is:

- A minimum of 3-5 years of agency relevant experience in research, traffic monitoring, database management, GIS or pavement management.

- Demonstrated ability to coordinate with, manage and organize the individuals and the processes that are needed to create the HPMS. The coordination function extends to upper management, technical staff, district engineers, local and regional planners, contractors and the FHWA division coordinator.

- An understanding of the policy context of the HPMS and its significance as a foundational element of national transportation policy and analysis.

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Timing and Scheduling

Having a schedule of data collection, processing, validation, and submission efforts that can be communicated with all parties involved streamlines the submittal process and improves the chances for a timely and accurate submittal.

Documentation of Practices

Documenting agency best practices and lessons learned was identified as one of the critical pieces of a best business model. Generally, the participants expressed the following as important issues related to HPMS process documentation:

- Organizational structure, coordination, and scheduling of data collection need to be documented.

- Database structure, data collection, validation, and submission processes should be part of the documentation.

- Documentation should be reviewed and updated regularly to capture the lessons learned, any recent changes in the organization, federal and state regulations, and the way HPMS process is conducted at the agency.

- Documentation should be easy to follow for new hires.

- Conflicts happen, even in a healthy working environment, and that is why agencies should have a documented process about how to identify conflicts, resolve them, and come up with improvements that will help avoid similar situations in the future. Participating agencies had differences in dealing with conflicts, but there was a consensus on the importance of a documented process or protocol for dealing with them.

Management and Coordination with both Internal and External Parties

Coordination with internal and external parties plays a major role in quality, timely submissions. Participants mentioned that their agencies had established coordination protocols, such as monthly calls with FHWA division office coordinator.

Quality Assurance, Quality Checks, and Validation

States employ different QA/QC and validation methods and tools to ensure quality submissions. These include tools developed in-house and utilizing field staff to validate data in the field. FHWA also emphasized the importance of QA/QC and validation checks before submission to FHWA, which can eliminate resubmissions. The HPMS software validation report can significantly improve the quality of the data.

Institutionalizing HPMS

An enterprise-wide commitment to the HPMS process is a major success factor, and there was consensus among the participants on this. This can be applied to all levels of organization, from the leadership level to the staff in the field. This requires a culture that is promoted and adopted across the agency, by the stakeholders involved with collection, processing, and submission of the HPMS data, and by the leadership that supports and provides resources for an agency's business processes.

4.5   Self-Certifying Business Model Checklist

As part of this project, a self-certifying business model checklist was developed that will help the HPMS coordinators and contributors focus on the tasks to be completed relative to the timeframe for submission. This checklist was designed based on the results of the expert study panel outreach, which identified main factors that reflect an agency's ability to develop and maintain an effective HPMS practice. These factors, highlighted by the study panel and called key "HPMS Dimensions" for the purpose of this checklist, are organized into six categories:

1. HPMS Team
2. HPMS Coordinator Authority
3. Timing and Schedule
4. Documentation of the HPMS Process and Conflict Resolution
5. Data Collection Quality Assurance and Quality Control (QA/QC)
6. Institutionalizing the HPMS Process

The study panel emphasized that the checklist should be simple enough to complete and update in a reasonable amount of time but complete enough to lead towards a deeper understanding of underlying challenges and successes in any follow up reviews.

It should be noted that this checklist applies only to the business and organizational aspect of the HPMS process, and does not provide technical guidance on field data collection, data formats, or internal HPMS data validation processes, among others. FHWA HPMS Field Manual or other state or agency specific materials may be consulted for technical details.

Who Should Use the Checklist

The essence of this self-certifying checklist is to provide an agency-specific set of actions regarding improvement of agency's HPMS practices. The HPMS coordinator may use this checklist, or the coordinator may designate another individual, knowledgeable of agency's HPMS processes and organizational structure, to go through the checklist. Alternatively, a group of and agency's HPMS stakeholders (for example data collectors)

may do the evaluation as a group, or it can be done by individuals in different positions in the agency to compare perspectives (for example leadership level, HPMS coordinator, and field data collectors).

Format of the Business Model Checklist

For each dimension of the HPMS process, multiple questions that address aspects of that dimension were added to the checklist. Questions are simple with "Yes/No" answers that can be easily answered in 10-15 minutes by an HPMS coordinator or any other HPMS stakeholder(s) with busy schedule who is familiar with the internal HPMS process, the stakeholders, and the organizational structure of the agency, without the need for significant time or research.

Each question carries a score that rolls up to the cumulative dimension score. This scoring system was devised to determine the maturity of the agency's HPMS practice as compared to best practices, which is the ultimate desired level. The total cumulative dimension score (TCDS) is then converted to Dimension Index (DI) of 0-100% of the maximum cumulative dimension score (MCDS) for each dimension that, in turn, determines the maturity level of that dimension (see HPMS Maturity Levels section).

$$Dimension\ Index\ (DI) = \frac{Total\ Cumulative\ Dimension\ Score\ (TCDS)}{Maximum\ Cumulative\ Dimension\ Score\ (MCDS)}$$

Depending on this comprehensive review and the maturity level, the checklist yields custom-tailored detailed guidance and improvement recommendations for the agency's current program (**Figure 4.6**). This is further explained in the HPMS Maturity Model section.

Figure 4.6. Self-Certifying Business Model Checklist Process
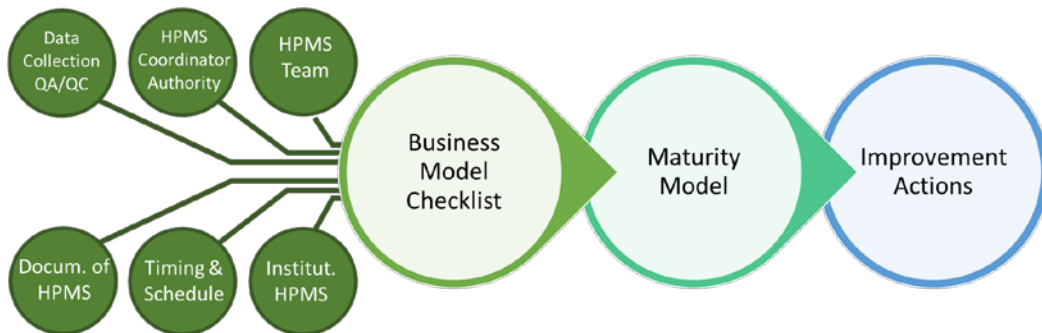
HPMS Maturity Model

Given the varied organizational structures, size of transportation networks, availability of resources, and complexity of internal coordination at state DOTs, leading to varied points of departure for the above-mentioned HPMS dimensions, a practical approach is to develop improvement strategies that can be implemented incrementally in manageable

steps. This model can become a management tool to improve the quality and timeliness of HPMS submittals at the state DOTs on a continuous basis.

Maturity models are used to improve processes in many technical realms. Similar models have been adopted by AASHTO and other transportation agencies, such as those outlined in AASHTO's Transportation Asset Management Guide (2013) and AASHTO Transportation Systems Management and Operations (TSM&O) Guidance. The latter is based on the framework emerged from the Strategic Highway Research Program 2 (SHRP2) L01 and L06 projects (FHWA-HOP-16-031, February 2016).

For this purpose, HPMS practice is presumed to be a process with the timely, quality HPMS submission to FHWA as an outcome. This checklist together with the maturity model identify a roadmap for the agency on how to achieve a targeted high level of capabilities and performance by focusing on a set of specific HPMS dimensions, that together support success of the HPMS process

The maturity model approach holds that implementing change is an evolutionary process that is achieved, monitored, evaluated, and managed through specific decisions and instructions. To be successful, change should be supported by upper management and by the agency's culture. These are further discussed in the next sections of this report.

HPMS Maturity Levels

In the maturity model, there are four levels of capability which represent a current (or desired) level of capability in support of an effective HPMS practice. These levels correspond to the dimension index obtained from the checklist. The first level, Initial (L1), reflects an ad hoc, inconsistent, fragmented practice, that is reliant on the heroic efforts of individuals. As agencies improve their practices and capabilities, they move up the capability levels characterized by increasing structure, integration, formality, documentation of processes, clear lines of authority, established schedules, and communication. Each level provides capabilities that are necessary for the agency to move to the next level of maturity. These four levels along with their respective scores ranges are illustrated in **Figure 4.7**.
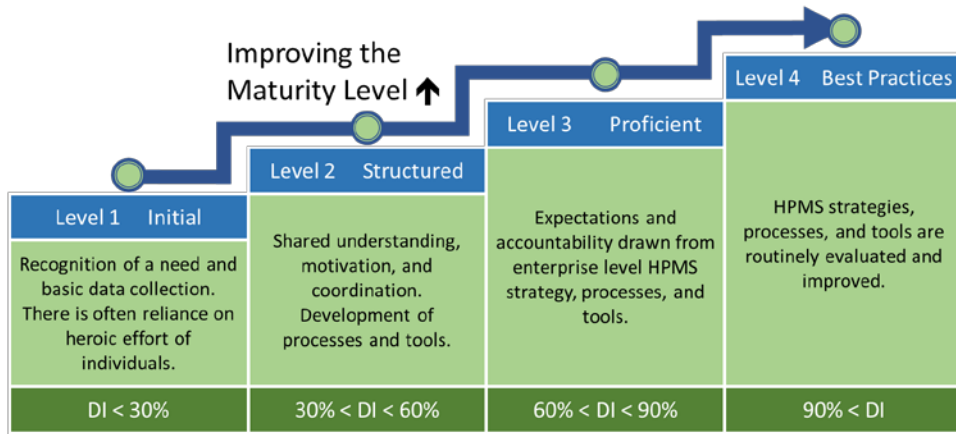
Figure 4.7. HPMS Capability Maturity Levels and Corresponding Dimension Indices (DI)

Figure 4.8 graphically illustrates the concept of maturity model for a sample state DOT. In this case, the agency self-evaluation produced the following results:

- HPMS Team .... Level 4 (Best Practices)
- HPMS Coordinator Authority .... Level 3 (Proficient)
- Timing and Schedule .... Level 3 (Proficient)
- Documentation of the HPMS Process...................................... Level 3 (Proficient)
- Data Collection QA/QC.. Level 2 (Structured)
- Institutionalizing the HPMS Process .... Level 2 (Structured)

Such graphical presentation along with recommended improvement actions can guide the agency in prioritizing their resources to advance the HPMS practice to the desired maturity levels.
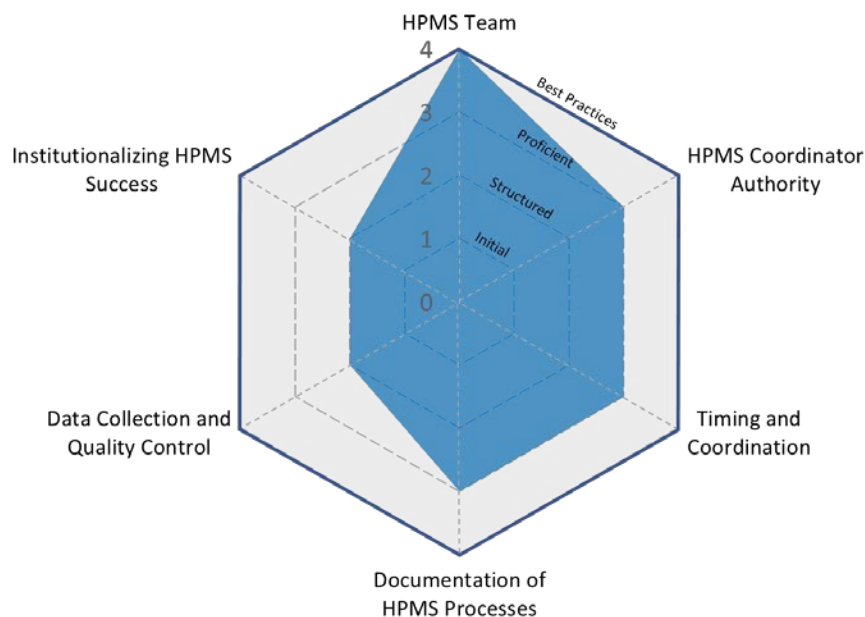
Figure 4.8. Graphical Presentation of the Example Agency's HPMS Capability Maturity

Improvement Recommendations

The goal of the maturity assessment is to improve processes that will produce high quality, timely HPMS submissions and avoid resubmissions. The self-certifying business model checklist determines the gaps in the HPMS practice at the agency. Agencies can then invest their efforts and resources on bridging those gaps gradually, based on an improvement plan.

The improvement plan should consider the availability of resources, the current state of the practice at the agency (current maturity level), the timeline for implementing improvements, and parties responsible for each improvement, and should be specific to the size and complexity and organizational structure of the state agency.

For example, an agency may plan to achieve the best practices level (maturity level 4) for Institutionalizing HPMS within the agency's culture from their current level (structured, level 2) in the next 3 years, whereas another agency may plan to improve from their current maturity level of proficient (level 3) to level 4 in the next year for that dimension.

The questions that were answered with a "No" in the checklist can serve as the improvement candidates. Improvement plan can be prioritized based on the score (or weight) of each question, with questions with higher scores having the higher priority.

4.6   Implementing Improvements Successfully

Those who have witnessed efforts to change organizational processes before can attest to the fact that most do not succeed. However, what the change strategies that do succeed have in common is that they approach a transformation by addressing the 'people' side of the organization before focusing on the 'processes' and 'tools' aspects of the business.

The essence of the business model checklist is to assist the state DOTs improve their HPMS processes to achieve a desired level of capabilities. If a coordinator wishes to improve performance, past practices may need to be discarded. This means changing people's behavior or broadly shared attitudes may need to change. Such efforts are challenging, whether or not they are related to implementing new processes and tools.

The AASHTO's Transportation Asset Management Guide (2013) offers some guidance for managing change in an organization, as adapted here for improving HPMS practices.

Setting Goals and Objectives

Change strategy starts with setting goals and objectives for the HPMS process by management, or a vision of what HPMS means to the agency in moving towards its mission, and how an internal commitment to the HPMS quality and timeliness will contribute to the success of the agency in achieving its objectives. To this end,

management and HPMS stakeholders need to clearly define goals and objectives for the agency's HPMS processes, identify the factors that drive these goals, and link the HPMS process to other agency businesses and processes.

Obtaining Internal Commitment

An important factor in ensuring success is obtaining internal commitment or buy-in to making it happen. It can be done by raising awareness within various levels of the agency on the benefits of a successful HPMS process, involving key stakeholders, setting short- and long-term milestones, providing training for staff, and establishing a continuous improvement plan for the HPMS program. It should be noted that gaining leadership support will be instrumental in implementing an effective and sustainable change strategy. **Appendix B** provides a sample elevator speech that can be used by the HPMS stakeholders (e.g. the HPMS Coordinator) to convey the importance of HPMS program to the leadership of the agency.

Developing a Change Strategy

Change efforts should be based on a change strategy, or an improvement plan. The strategy should include activities that will convince people that the change is necessary, and will create a change coalition that will spearhead the change within the agency.

The goal of the strategy should be to instill the change into the organizational culture of the agency, and as such, it should be clearly communicated with those affected, and people should be empowered to push the strategy forward. People's opinion should be heard and the change should be based on mutual respect and trust.

Linking the Strategy to Other Agency Businesses

Changes may also require establishing new business processes, such as data collection, management, processing, or reporting efforts or tools, that did not exist before the change. It is critical to ensure such changes are in the context of the existing agency business processes and in support of agency strategic and operational plans.

Establishing HPMS Roles and Authorities

HPMS submittals require a diversified team of experts. However, the size of this group depends on how sophisticated the agency is and how much of the public roadway (including Federal-aid) system it manages. For some agencies, the process may rely on efforts of an HPMS coordinator, and for others it may rely on a few scattered staff in different offices or regions, who have a multi-disciplinary background. However, as the agency moves up the capability maturity levels, it will require a more structured, coordinated HPMS leadership team that will sustain the change strategy and will maintain the improved quality of HPMS process. This may require establishing new roles or lines of authority within the agency or within the HPMS group. It may also involve engaging individuals from other units or groups who have a stake or role in timely HPMS

submissions. This can be in the form of a structured HPMS committee with the senior managers chairing the committee and the HPMS coordinator serving as the committee coordinator, or any other format deemed fit by the agency leadership. Nonetheless, these will not be successful without formal support of the agency managers.

Evaluating the Change Effectiveness

To evaluate the effectiveness of the change strategy in improving quality and timeliness of the HPMS process, the agency will need to implement a performance monitoring or evaluation plan in which the feedback obtained through such evaluations inform the future direction of the strategy.

This checklist was designed based on the results of the expert study panel outreach, which identified main factors that reflect an agency's ability to develop and maintain an effective HPMS practice. These factors were highlighted by the Study Panel, and are called key "HPMS Dimensions" for the purpose of this checklist. (**Figure 4.9**) These six dimensions are:

1. HPMS Team,
2. HPMS Coordinator Authority,
3. Timing and Schedule,
4. Documentation of the HPMS Process and Conflict Resolution,
5. Data Collection Quality Assurance and Quality Control (QA/QC), and
6. Institutionalizing the HPMS Process.
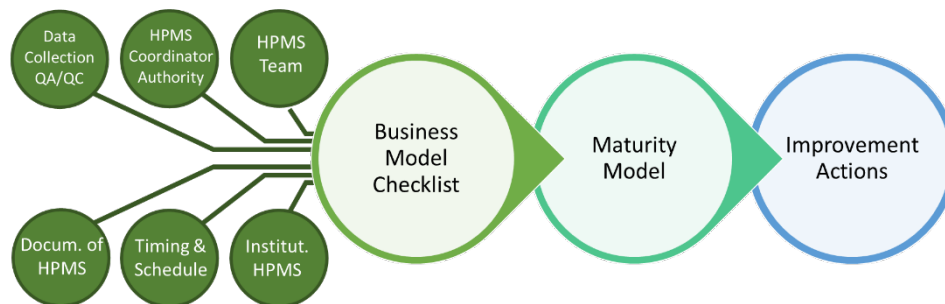
Figure 4.9. Self-Certifying Business Model Checklist Process

4.7   Format of the Business Model Checklist

For each dimension of the HPMS process, multiple questions that address aspects of that dimension were added to the checklist. Questions are simple with "Yes/No" answers that can be easily answered in 10-15 minutes by an HPMS coordinator or any other HPMS stakeholder(s) with busy schedule who is familiar with the internal HPMS process, the stakeholders, and the organizational structure of the agency, without the need for significant time or research.

Each question carries a score that rolls up to the cumulative Dimension score. This scoring system was devised to determine the maturity of the agency's HPMS practice as compared with best practices, which is the ultimate desired level. These scores are then converted to a scale of 0-100% of the cumulative score for each dimension that, in turn, determines the maturity level of that dimension (see HPMS Maturity Levels section).

4.8   HPMS Maturity Model

Given the varied organizational structures, size of transportation networks, availability of resources, and complexity of internal coordination at state DOTs, leading to varied points of departure for the abovementioned HPMS dimensions, a practical approach is to develop improvement strategies that can be implemented on an incremental basis. Developing an HPMS Maturity Model approach can provide valuable guidance in reducing the complexity of this task to a manageable, practical level. This model can become a management tool to guide improvement of HPMS as an established program at the state DOTs on a continuous basis.

For this purpose, HPMS practice is presumed to be a process with the timely, quality HPMS submission to FHWA as an outcome. This checklist together with the maturity model identify a roadmap for the agency of how to achieve a targeted high level of capabilities and performance by focusing on a set of specific HPMS dimensions, that together support such capability levels.

4.9   HPMS Maturity Levels

In the maturity model, four levels of capability are considered for each of the six dimensions, which represent current (or desired) level of capability in support of an effective HPMS practice. These levels correspond to the score for each dimension obtained from the checklist on a scale of 0-100% of the cumulative score for each dimension (100% being the highest level of maturity). The first level, Initial (Level 1), reflects an ad hoc, inconsistent, fragmented practice, that is reliant on heroic efforts of individuals. As agencies improve their practices and capabilities, they move up the capability levels characterized by increasing structure, integration, formality, documentation of processes, clear lines of authority, established schedules, and communication. Each level provides capabilities that are necessary for the agency to move to the next level of maturity. These four levels, along with their respective scores ranges, are illustrated in **Figure 4.10**.
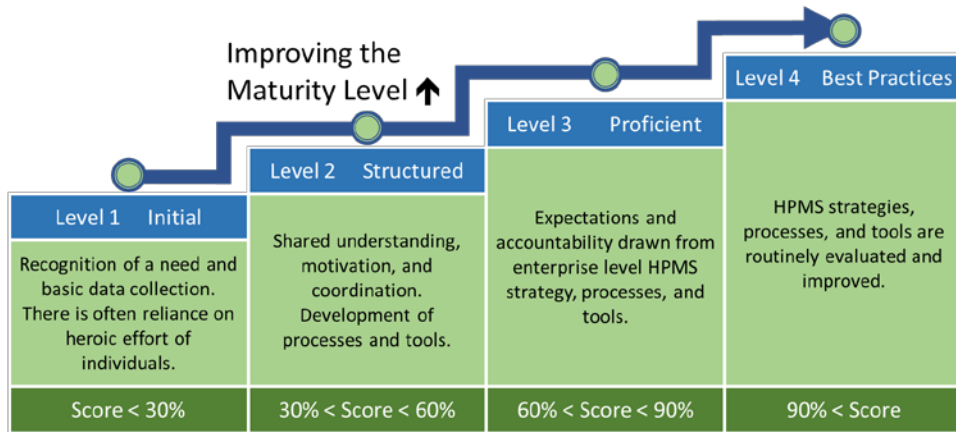
Figure 4.10. HPMS Capability Maturity Levels

4.10   Graphical Presentation of the Assessment

Figure 4.11 can be used to visualize the capability maturity levels for each dimension, giving the agency an overview of how their state-of-the-practice compares with best practices, and in which dimension the agency can improve. For this purpose, maturity level for each dimension can be located on the respective axis, and then all dots can be connected.
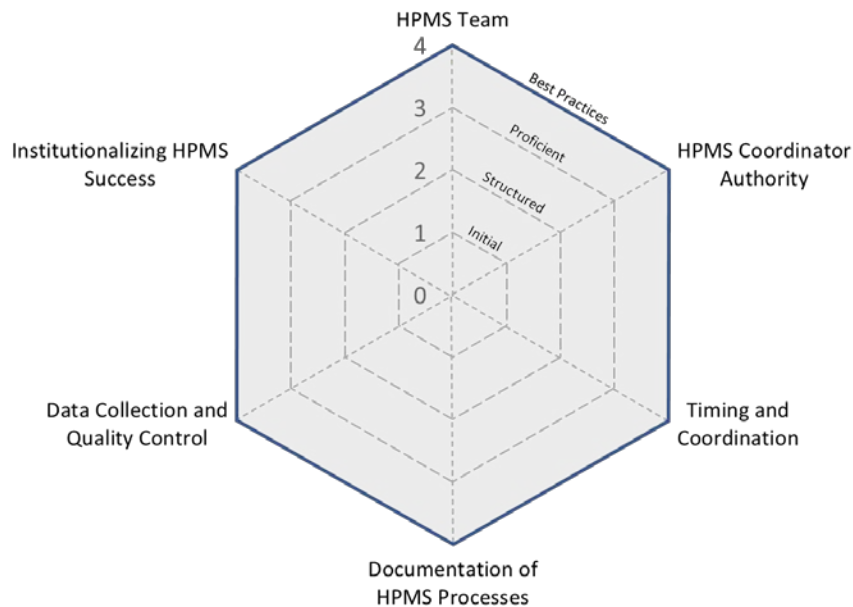
Figure 4.11. Radar Chart for Graphical Presentation of the Agency's HPMS Capability Maturity

Figure 4.12 illustrates this concept for an example agency. In this case, the agency self-evaluation produced the following results:

- HPMS Team .... Level 4 (Best Practices)
- HPMS Coordinator Authority .... Level 3 (Proficient)
- Timing and Schedule .... Level 3 (Proficient)
- Documentation of the HPMS Process...................................... Level 3 (Proficient)
- Data Collection QA/QC... Level 2 (Structured)
- Institutionalizing the HPMS Process .... Level 2 (Structured)
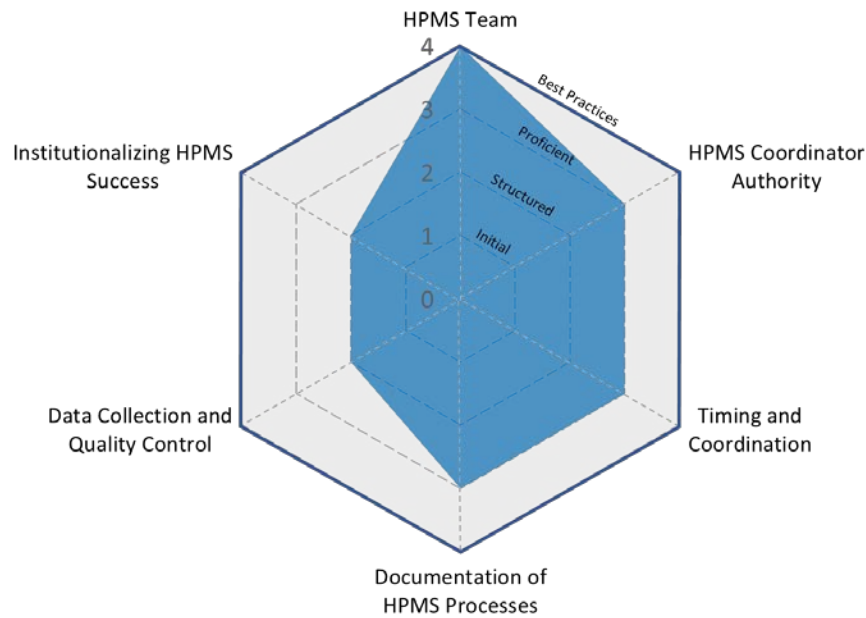
Figure 4.12. Graphical Presentation of the Example Agency's HPMS Capability Maturity

4.11   HPMS Business Process Checklist

General Information

0.1. Please choose the category that best matches your function as it relates to the HPMS:
- ☐ HPMS Coordinator
- ☐ HPMS Support Staff
- ☐ District Engineer
- ☐ Non-DOT Data Provider
- ☐ HPMS Committee Chair
- ☐ State DOT Chief Engineer
- ☐ HPMS Data Collection Engineer

0.2. What is your tenure with the agency in this position?
- ☐ Less than 5 years
- ☐ More than 5 years

1. HPMS Team	**Total Cumulative Score: __of 16**
	Score: ___%

Team Organization

1.1. There is an HPMS coordinator responsible for scheduling the data collection process, and submission of HPMS Data to FHWA. The contact information of the HPMS coordinator, along with lines of reporting and supervision in the organization, is available to the HPMS stakeholders.
   ☐ Yes   Score: 1.5
   ☐ No

1.2. There is a complete, up-to-date contact list of internal team partners, along with a clearly written description of their roles and responsibilities in the HPMS development process, their department/division/office, their supervisors, and their backups, that is available to everyone on the team. This document is maintained by the HPMS coordinator (Refer to Org Chart).
   ☐ Yes   Score: 1
   ☐ No

1.3. The agency maintains an organizational chart for the HPMS "team" that is available to the HPMS stakeholders, and this document is updated by the HPMS coordinator when there is a change in the HPMS team or agency's organizational chart and lines of reporting.
   ☐ Yes   Score: 0.5
   ☐ No

1.4. The agency has a standing committee/group of stakeholders responsible for the oversight of the annual HPMS submittals to FHWA.
   ☐ Yes   Score: 0.5
   ☐ No

1.5. There is a complete, up-to-date list of external partners, along with their contact information, affiliations and respective responsibilities in the HPMS process, and their supervisors, that is available to everyone on the team, and this document is updated by the HPMS coordinator.
   ☐ Yes   Score: 0.5
   ☐ No

HPMS Team Meetings

1.6. At the beginning of each HPMS cycle, the HPMS coordinator meets with the internal HPMS team to discuss the schedule of data collection, processing and submission. (See Schedule section for more)
   ☐ Yes   Score: 1
   ☐ No

1.7. The HPMS coordinator holds regular internal coordination meetings.
   ☐ Yes, and they are scheduled.   Score: 1
   ☐ No, or they are on as needed basis.

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1.8. FHWA division office liaison is invited to participate in the team meetings on a regular basis.
- ☐ Yes   Score: 1
- ☐ No

HPMS Team Resources and Qualifications

1.9. The HPMS team has adequate resources available (including SPR, etc.) that can support a timely and quality HPMS submission, including human resources, equipment and funding.
- ☐ Yes   Score: 1.5
- ☐ No

1.10. The HPMS duties are included as part of the written job description for the HPMS coordinator position. It describes qualifications such as the minimum level of experience, HPMS knowledge, and knowledge of the agency's organization and policies
- ☐ Yes   Score: 1
- ☐ No

1.11. There are GIS/LRS, traffic monitoring, pavement asset management, and roadway inventory experts on the team, and at least one member of the team is knowledgeable about statistics and understands how to conduct unbiased sample section selections.
- ☐ Yes   Score: 1.5
- ☐ No

1.12. At least one member of internal HPMS team is knowledge of HPMS sampling procedures, and has a background in and understanding of statistics.
- ☐ Yes   Score: 1.5
- ☐ No

Commitment and Communication

Internal Coordination:

1.13. During each cycle, each team member understands their action items, and the HPMS coordinator fully understands the update status of all data items at all times.
- ☐ Yes   Score: 0.5
- ☐ No

1.14. The offices responsible for the GIS/LRS, traffic monitoring, pavement asset management, and roadway inventory contributions are fully committed to providing data in a timely manner. There may be an MOU that defines this commitment.
- ☐ Yes   Score: 1
- ☐ No

External Coordination:

1.15. The HPMS coordinator has regular communications with the FHWA Liaison/State Coordinator, local governments/MPOs that provide HPMS data, and the external contractors responsible for HPMS data collection.
- ☐ Yes   Score: 1
- ☐ No

1.16. The HPMS team has contracts, memoranda of understanding (MOU) or agreements that define data sharing and data provision arrangements, including delivery schedules with external partners
- ☐ Yes   Score: 1
- ☐ No

2. HPMS Coordinator Authority	**Total Cumulative Score: ___of 4** **Score: ___%**

2.1. What is the scope of management, or the supervisory authority of the HPMS coordinator over data collection responsible parties?
- ☐ Supervisory relationship with the internal HPMS data submitters
- ☐ Collegial relationship with the internal HPMS data submitters

2.2. If collegial and needed, can coordinator speak directly to colleague's supervisor?
- ☐ Yes   Score: 1
- ☐ No

2.3. This authority or scope of management, and lines of reporting are documented and supported by the leadership at the agency.
- ☐ Yes   Score: 1
- ☐ No

2.4. HPMS coordinator is responsible for setting the schedule for data collection throughout the year for each major category of data and process, and the coordinator has authority regarding the schedule.
- ☐ Yes   Score: 1
- ☐ No

2.5. HPMS coordinator and/or HPMS committee has the authority to provide additional resources including budget and human resources to meet deadlines and quality needs.
- ☐ Yes   Score: 1
- ☐ No

3. Timing and Coordination	**Total Cumulative Score: ____ of 4** **Score: ___%**

3.1. There are scheduled milestones throughout the HPMS annual cycle (e.g. monthly, quarterly, or semi-annually meetings or conference calls) to check the progress with the responsible parties and resolve potential issues.
- ☐ Yes   Score: 1
- ☐ No

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3.2. The data collection schedules are timed, phased, coordinated and approved by responsible parties to ensure that all data submittal deadlines are met. This includes incorporating critical path items and time constraints for certain data such as traffic data that may require additional processing.
- ☐ Yes   Score: 1
- ☐ No

3.3. Coordination with each office responsible for providing data is included in the schedule.
- ☐ Yes   Score: 1
- ☐ No

3.4. Schedule accommodates changes that could affect the HPMS process later in the year (e.g. change of urban boundaries).
- ☐ Yes   Score: 1
- ☐ No

4. Documentation of HPMS Processes	Total Cumulative Score: ___ of 5.5 Score: ___%

4.1. At a minimum, the documentation covers the following items.

4.1.1. A schedule of activities, including a clearly defined schedule for the transmittal of data to the HPMS coordinator.
- ☐ Yes Score: 0.5
- ☐ No

4.1.2. An HPMS organizational chart, preferably one that indicates percentage of staff time dedicated to HPMS.
- ☐ Yes Score: 0.5
- ☐ No

4.1.3. Description of how data is updated, validated and submitted.
- ☐ Yes Score: 0.5
- ☐ No

4.1.4. References to technical documentation on database schema.
- ☐ Yes Score: 0.5
- ☐ No

4.1.5. Description of how off-system and on-system data are handled differently.
- ☐ Yes Score: 0.5
- ☐ No

4.1.6. Guidelines for addressing invalid or missing data.
- ☐ Yes Score: 0.5
- ☐ No

4.1.7. A defined process for accepting data, or for rectifying rejected submittals.
- ☐ Yes Score: 0.5
- ☐ No

4.2. There is an established and documented process for identifying and resolving issues (such as missed deadlines) and conflicts, and the documentation is available to all stakeholders involved with the HPMS process.

☐ Yes Score: 1
☐ No

4.3. The HPMS Documentation is frequently update

☐ Yes Score: 1
☐ No

5. Data Collection and Quality Control	Total Cumulative Score: ____ of 10
	Score: ___%

5.1. HPMS coordinator or the HPMS Committee is responsible for defining data collection needs.

☐ Yes Score: 1
☐ No

5.2. The HPMS data collection, processing and submission is built upon requirements of FHWA's HPMS Field Manual, is based on a GIS/LRS foundation, and supports federal performance management rulemaking

☐ Yes Score: 1
☐ No

5.3. The agency collects, or arranges to collect, off-state system data.

☐ Yes Score: 1
☐ No

5.4. The agency has a central portal for internal data providers and local agencies to submit their data, this process is documented, and if there is no portal, there is a documented process for data providers to submit their data with quality and format consistency, and the agency conducts quality checks on all data submittals.

☐ Yes Score: 1
☐ No

5.5. Additional data needs and data fixes are communicated with the internal and external parties.

☐ Yes Score: 1
☐ No

5.6. Local partners have the capacity to collect and distribute good quality data in timely manner, and there is financial support for agencies to collect this data

☐ Yes Score: 1
☐ No

5.7 The process of acquiring HPMS data from internal or external sources and organizing it into the HPMS submittal format is automated.

☐ Yes Score: 1
☐ No

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5.8 The HPMS coordinator oversees or conducts the data quality checks and validations prior to submission to FHWA.

☐ Yes   Score: 1
☐ No

5.9 There is an enterprise system for validating data prior to submission to FHWA, this system is documented

☐ Yes   Score: 1
☐ No

5.10 The submittal schedule includes adequate time for producing Certified Mileage report to FHWA by June 1.

☐ Yes   Score: 1
☐ No

6. Institutionalizing HPMS Success	Total Cumulative Score: ____of 10 Score: ___%

Continuous Process Improvements (CPI)

6.1. The agency has a CPI plan that covers actions for improvements, responsible parties or offices, timeline of the implementation, and success measures, and the HPMS coordinator responsible for developing and updating this plan.

☐ Yes   Score: 1
☐ No

6.2. The team holds a debriefing meeting after each annual submittal, and the lessons learned are documented and communicated with the entire HPMS team.

☐ Yes   Score: 1
☐ No

6.3. The agency continually monitors the process and how improvements impact timely and quality submittals, and revises the plan as necessary, and the HPMS coordinator is responsible for monitoring the progress.

☐ Yes   Score: 1
☐ No

6.4. HPMS team members have access to regular training opportunities for continuous HPMS process improvement, through internal resources, conferences or FHWA-sponsored courses.

☐ Yes   Score: 1
☐ No.

6.5. There is a training course as part of HPMS new hire's orientation.

☐ Yes   Score: 1
☐ No

Organizational Commitment to HPMS

6.6. There is a high-level commitment to the success of HPMS, and the agency's leadership understands the importance of timely and quality HPMS submittals to the agency.
- ☐ Yes   Score: 1
- ☐ No

6.7. HPMS coordinator reports the progress of HPMS to upper management within the agency and there are communication channels/meetings for this purpose.
- ☐ Yes   Score: 1
- ☐ No

6.8. Issues affecting successful submission are reported to the upper management.
- ☐ Yes   Score: 1
- ☐ No

6.9. This commitment comes from the management levels that influence the HPMS components such as data-collection, LRS, inventory, and pavements.
- ☐ Yes   Score: 1
- ☐ No

6.10.   There a process to educate the new administration/leadership on the importance of HPMS.
- ☐ Yes   Score: 1
- ☐ No

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5. Developing Self-Certifying HPMS Data Quality Checklist

Section 5 presents a self-certifying checklist was developed that will help the HPMS coordinators and contributors focus on continuous data quality improvement. This checklist was designed based on the results of the expert study panel outreach, and focuses on five areas:

1. Linear Referencing Systems
2. Data Assessment and Quality Control
3. Traffic Data
4. Pavement
5. Sample Adequacy

The section begins with a discussion of the HPMS and its data items, continues with instructions for completing the checklist and concludes with the checklist itself.

5.1 Importance of HPMS Data Quality Management

Quality data which accurately represent the travel characteristics and extent of the Nation's highway system is an objective of FHWA, and one of the pillars of the HPMS program. In addition, the data that state DOTs collect for HPMS, in many cases, is also being used for other agency program, such as pavement and traffic management. Thus, having quality data is critical. Implementation of the HPMS 2010+ system has provided the states and the FHWA with many quality control and visualization features, including the Validation Summary Report and the GIS features, enabling validation of data and graphical review of samples and sections data.

In addition, many forecasting models, such as life-cycle planning models and cost allocation models are sensitive to accurate and temporally consistent data, and low-quality, inaccurate data can have a significant effect on the recommended treatments and plans.

There are two types of data errors; systematic and random. Systematic errors are more critical, especially for analysis at the network level, where errors can be compounded. Random errors may be less critical in this context, especially if large amount of data is

collected in which these errors may offset each other. Effective data quality management programs can help eliminate systematic and minimize random errors.[1]

5.2 HPMS Data to be Reported

States report the data items as listed in **Table 5.1**, which includes five types of data items: Inventory, Route, Traffic, Geometric, and Pavement data. **Table 5.1** also lists the use and sensitivity of forecasting models to these data items. Detailed information on coding instructions, extent requirements, and additional guidance for each data item can be found in the *HPMS Field Manual*.

Table 5.1. HPMS Data Items and Their Use

Data Item Type	Item #	Data Item Name	Due Date	Use						Forecasting Model Outcomes Sensitive to Data Item
				Highway Statistics	Investment Reqs. Modeling & Cap. Calcs.	Apport., Admin., Legis., and Natl. Highway Databases	Cost Alloc. Pavement Model	Performance Measures	Pavement Modeling	
Inventory	1	Functional System	April 15✤	●				●		
	2	Urban Code	April 15✤	●						
	3	Facility Type	April 15✤	●	●			●		●
	4	Structure Type	April 15✤					●		
	5	Access Control	June 15	●	●	●				●
	6	Ownership	June 15	●		●				
	7	Through Lanes	April 15✤	●		●		●		
	8	Managed Lane Operations Type	June 15			●				
	9	Managed Lanes	June 15			●				
	10	Peak Lanes	June 15		●					●
	11	Counter Peak Lanes	June 15		●					●
	12	Right Turn Lanes	June 15		●					●
	13	Left Turn Lanes	June 15		●					●
	14	Speed Limit	June 15		●					●
	15	Toll Charged	June 15			●				
	16	Toll Type	June 15			●				
Route	17	Route Number	June 15			●				
	18	Route Signing	June 15			●				
	19	Route Qualifier	June 15			●				
	20	Alternative Route Name	June 15			●				

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[1] Shekharan, R., D. Frith, T. Chowdhury, C. Larson, and D. Morian, "Effects of Comprehensive Quality Assurance/ Quality Control Plan on Pavement Management," Transportation Research Record: Journal of the Transportation Research Board, No. 1990, Transportation Research Board of the National Academies, Washington, D.C., 2007, pp. 65–71.

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Data Item Type	Item #	Data Item Name	Due Date	Use						Forecasting Model Outcomes Sensitive to Data Item
				Highway Statistics	Investment Reqs. Modeling & Cap. Calcs.	Apport., Admin., Legis., and Natl. Highway Databases	Cost Alloc. Pavement Model	Performance Measures	Pavement Modeling	
Traffic	21	Annual Average Daily Traffic	June 15	●		●		●		
	22	Single Unit Truck and Bus AADT	June 15		●			●		●
	23	% Peak Single-Unit Trucks and Buses	June 15		●					●
	24	Combination Truck AADT	June 15		●			●		●
	25	Percent Peak Combination Trucks	June 15		●					●
	26	K-factor	June 15		●		●			●
	27	Directional Factor	June 15				●			●
	28	Future AADT	June 15		●		●			●
	29	Signal Type	June 15		●					●
	30	Percent Green Time	June 15		●					●
	31	# Signalized Intersections	June 15		●					●
	32	# Stop Sign-Controlled Intersections	June 15		●					●
	33	Number of Intersections, Type - Other	June 15		●					●
Geometric	34	Lane Width	June 15	●	●		●			●
	35	Median Type	June 15	●	●	●				●
	36	Median Width	June 15	●	●	●				●
	37	Shoulder Type	June 15		●					●
	38	Right Shoulder Width	June 15		●					●
	39	Left Shoulder Width	June 15		●					●
	40	Peak Parking	June 15		●					●
	41	Widening Obstacle	June 15			●				
	42	Widening Potential	June 15		●					●
	43	Curve Classification	June 15		●					●
	44	Terrain Type	June 15		●					●
	45	Grade Classification	June 15		●					●
	46	Percent Passing Sight Distance	June 15		●					●
Pavements	47	International Roughness Index	April 15✣	●	●			●		●
	48	Present Serviceability Rating	April 15✣	●	●			●		●
	49	Surface Type	April 15✣	●	●		●	●		●
	50	Rutting	April 15✣					●	●	●

| Data Item Type	Item #	Data Item Name	Due Date	Use						
				Highway Statistics	Investment Reqs. Modeling & Cap. Calcs.	Apport., Admin., Legis., and Natl. Highway Databases	Cost Alloc. Pavement Model	Performance Measures	Pavement Modeling	Forecasting Model Outcomes Sensitive to Data Item
	51	Faulting	April 15✤					●	●	●
	52	Cracking Percent	April 15✤					●	●	●
	54	Year of Last Improvement	June 15				●			●
	55	Year of Last Construction	June 15						●	●
	56	Last Overlay Thickness	June 15						●	●
	57	Thickness Rigid	June 15		●		●			●
	58	Thickness Flexible	June 15		●		●			●
	59	Base Type	June 15						●	●
	60	Base Thickness	June 15						●	●
	61	Climate Zone⌘	June 15				●			●
	62	Soil Type⌘	June 15						●	●
Inventory	63	County Code	June 15							
Special Networks	64	National Highway System	April 15✤	●		●		●		
	65	Strategic Highway Network	June 15	●		●				
	66	National Highway Freight Network	June 15			●				
	67	Future National Highway System	June 15			●				
Inventory	68	Maintenance & Operations	June 15			●				
Traffic	69	Capacity	June 15		●		●			●
Inventory	70	Directional Through Lanes	April 15					●		

✤ *This data item is required to be submitted for Interstate roadways by April 15th; conversely, this data item is required to be submitted for all non-Interstate roadways by June 15th.*

⌘ *States have the option to override initial codes assigned by FHWA*

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5.3   Purpose of the Data Quality Checklist

As part of this project a self-certifying HPMS data quality checklist is developed which is intended to help HPMS coordinators or other personnel involved with HPMS submissions perform a self-assessment of their data quality. The self-certifying items in the checklist cover HPMS data collection process, procedure, practice, and data submission.

The need for timely and accurate submittals has become more acute, as the HPMS has become a principal tool for state and national performance management. The deadlines for submittals has moved up in the calendar year and FHWA soon will have less flexibility than previously to accept multiple and late submittals. FHWA officials have organized their activities around an expectation that the national database will be "frozen" by April16th for Interstate, June 16th for the NHS with data extraction for the annual performance assessments on June16th and August 16th, respectively. The current deadlines are displayed in **Figure 5.1**.
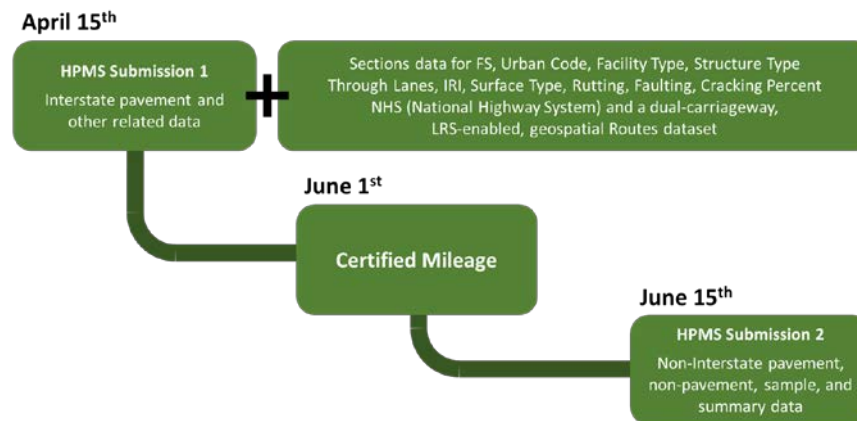
Figure 5.1. HPMS Submittal Schedule

5.4   Format of the Data Quality Checklist

For each dimension of the HPMS process, multiple questions that address aspects of that dimension were added to the checklist. Questions are simple with "Yes/No" answers that can be easily answered in 10-15 minutes by an HPMS coordinator or any other HPMS stakeholder(s) with busy schedule who is familiar with the internal HPMS process, the stakeholders, and the organizational structure of the agency, without the need for significant time or research.

Each question carries a score that rolls up to the cumulative dimension score. This scoring system was devised to determine the maturity of the agency's HPMS practice as compared with best practices, which is the ultimate desired level. These scores are then converted to a scale of 0-100% of the cumulative score for each dimension that, in turn, determines the maturity level of that dimension (see HPMS Maturity Levels section).

5.5   Self-Certifying HPMS Data Quality Checklist

0.   General Information

0.1.   Agency   _____

0.2.   Assessment Year   _____

0.3.   This Year's Data Quality Score _____   Last Year's Data Quality Score _____

0.4.   Please choose the category that best matches your current position as related to the HPMS:

☐   HPMS Coordinator

☐   HPMS Support Staff

☐   District Engineer

☐   Non-DOT Data Provider

☐   HPMS Committee Chair

☐   State DOT Chief Engineer

☐   HPMS Data Collection Engineer

0.5.   What is your tenure with the agency in this position?

☐   Less than 5 years

☐   More than 5 years

0.6.   Did the State completed its data submittal as outlined below with no major deficiencies?

HPMS Submission #1 (April 15)   Interstate pavement and other related data

HPMS Submission #2 (June 15)   Non-Interstate pavement, non-pavement, samples, and summary data

☐ Yes   ☐ No   ☐ Not Applicable

0.7.   Did the State's submittal comments adequately explain recurring conditions, edits, changes and improvements being made in data collection procedures and processing data?

☐ Yes   ☐ No   ☐ Not Applicable

0.8.   Does the State collect (rather than acquire) data for at least some portion of the off-State system roadways?

☐ Yes   ☐ No   ☐ Not Applicable

1.   Linear Referencing System (LRS/ GIS Systems)

1.1.   Does the network submittal reflect the entire Federal-Aid System at a minimum?

☐ Yes   ☐ No   ☐ Not Applicable

1.2. Does the network submittal include the All Roads Network of Linear Referenced Data (ARNOLD)?

☐ Yes   ☐ No   ☐ Not Applicable

1.3. Is the on-state system LRS network tested for connectivity and accuracy?

☐ Yes   ☐ No   ☐ Not Applicable

1.4. Is the on-state system LRS network free of anomalies such as overlapping and multipart features?

☐ Yes   ☐ No   ☐ Not Applicable

1.5. Is the GIS derived or otherwise integrated with the state's enterprise system?

☐ Yes   ☐ No   ☐ Not Applicable

1.6. Is route ID, functional system, (private roads identifier), facility type and ownership provided for all public roads?

☐ Yes   ☐ No   ☐ Not Applicable

2. Data Quality Assurance and Quality Control (QA/QC)

2.1. After the agency loads data (and conducts data QA/QC procedures) in the HPMS software, were any major problems found corrected?

☐ Yes   ☐ No   ☐ Not Applicable

2.2. Did the State conduct a Field Inventory Review (including both field visits and remote viewing) within the past year to verify data is coded properly and reflects current conditions and inventory information, and have major problems/issues been rectified before loading data in the HPMS software?

☐ Yes   ☐ No   ☐ Not Applicable

2.3. Is the State conducting quality checks using the HPMS software or an in-house system?

☐ Yes   ☐ No   ☐ Not Applicable

2.4. If the HPMS Validation Summary Report contains many fixable errors, has justification and explanation been provided for these errors in the HPMS submittal comments?

☐ Yes   ☐ No   ☐ Not Applicable

2.5. If the HPMS submittal process has identified errors at specific locations that occur repeatedly, has the State taken steps to address them?

☐ Yes   ☐ No   ☐ Not Applicable

3. Traffic Data

3.1. Does the state's traffic database provide the same data for HPMS as is used for the agency's business processes?

☐ Yes   ☐ No   ☐ Not Applicable

3.2. Does the state document and regularly review its procedures for collecting, factoring, analyzing and storing traffic volume data?

☐ Yes ☐ No ☐ Not Applicable

3.3. Does the state follow FHWA and/or AASHTO procedures for data collection, factoring, analyzing, updating and storing traffic volume data? This includes:

3.3.1. Continuous count accuracy checking, editing, automation, imputation and equipment maintenance?

☐ Yes ☐ No ☐ Not Applicable

3.3.2. Applying appropriate factors for day of week, month of year, axle correction and year-over-year growth?

☐ Yes ☐ No ☐ Not Applicable

3.3.3. Procedures for counting and factoring program for single unit and combination unit trucks?

☐ Yes ☐ No ☐ Not Applicable

3.3.4. Procedures for using coverage counts collected by MPOs, ITS, local agencies and contractors?

☐ Yes ☐ No ☐ Not Applicable

3.4. Are there a sufficient number of continuous count locations to achieve the 10 percent precision and 95 percent confidence level for seasonal pattern group factoring (as per TMG guidance)?

☐ Yes ☐ No ☐ Not Applicable

3.5. For each continuous count location, is there is one full days' worth of data for each day of the week and for each month of the year?

☐ Yes ☐ No ☐ Not Applicable

3.6. Does the state conduct 48-hour or greater coverage counts on a minimum of one-third of all NHS and Principal Arterial System (PAS) count locations each year?

☐ Yes ☐ No ☐ Not Applicable

3.7. For traffic volumes, are all other roadway sections, including ramps, counted on a minimum six-year cycle?

☐ Yes ☐ No ☐ Not Applicable

3.8. Does the state use site or route specific peak hour factors (K) and directional factors (D) that are updated regularly?

☐ Yes ☐ No ☐ Not Applicable

3.9. Does the state check VMT and growth rates for reasonableness before submittal?

☐ Yes ☐ No ☐ Not Applicable

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3.10. Does the state perform visual checks of the traffic volume data (for example, checking progression of inbound/outbound mainline and ramp volumes in GIS application) before submittal?

☐ Yes ☐ No ☐ Not Applicable

4. Pavement Data

4.1. Does the pavement data (NHS) that is provided fully meet the performance measure requirements as intended under MAP-21/FAST Act (i.e. includes IRI, PSR, Rutting, Faulting, and Cracking data in accordance with requirements of the rulemaking), and has the data has been updated within the last 1 or 2 years as required?

☐ Yes ☐ No ☐ Not Applicable

4.2. If the answer to the previous is "No", is there a plan of corrective action in place to rectify this compliance issue?

☐ Yes ☐ No ☐ Not Applicable

4.3. Does the pavement data collection process meet the quality specifications outlined in the HPMS Field Manual, including certified data collection equipment and operator?

☐ Yes ☐ No ☐ Not Applicable

4.4. Are all sample sections (including all paved NHS and Interstate full extent sections) coded with Surface Type coding and do all paved sample sections (including NHS) include pavement distress data as appropriate?

☐ Yes ☐ No ☐ Not Applicable

4.5. Does the pavement roughness data reported in HPMS include bridges and railroad crossings?

☐ Yes ☐ No ☐ Not Applicable

4.6. Are the State's pavement roughness and distress reports tied to the State's current linear referencing system (LRS) to accurately locate the sections?

☐ Yes ☐ No ☐ Not Applicable

4.7. Does the State use one consistent inventory direction for reporting pavement roughness and distress in HPMS and does the State use the same direction each time (Example: east to west or south to north)?

☐ Yes ☐ No ☐ Not Applicable

4.8. As specified in the HPMS Field Manual, when collecting roughness and distress data, does the State also collect and report pavement metadata as a byproduct of the pavement data collection effort?

☐ Yes ☐ No ☐ Not Applicable

4.9. Is there a pavement data collection quality assurance plan in place that addresses daily quality control equipment procedures (accelerometers & non-contact sensors), a schedule for accuracy checks of roughness /distress equipment,

pavement roughness survey personnel training records, and a schedule for the regular calibration of roughness equipment? (Reference Practical Guide for Quality Management of Pavement Condition Data Collection)

☐ Yes ☐ No ☐ Not Applicable

5. Sample Adequacy

5.1. Has the State conducted a sample adequacy review this year, ensured that the number of samples per volume group met the sampling requirements, explained the changes in number of samples or when last review was conducted (3-year interval maximum).

☐ Yes ☐ No ☐ Not Applicable

5.2. Are samples fully populated and adjusted to incorporate the most recently-established decennial Census boundaries (Federal-aid adjusted urbanized area boundaries)?

☐ Yes ☐ No ☐ Not Applicable

5.3. If there are un-sampled, under-sampled, or oversampled volume groups, is there a plan to address the issue?

☐ Yes ☐ No ☐ Not Applicable

5.4. Has the State taken steps to eliminate bias in the sample selection process by using a valid random sample selection process (or the HPMS software), considering all on- and off-system roadway sections, and producing at least three samples in each traffic volume group whenever possible?

☐ Yes ☐ No ☐ Not Applicable

5.5. Have steps been taken to ensure that no volume groups have expansion factors greater than 100.00?

☐ Yes ☐ No ☐ Not Applicable

5.6. Has the State reviewed the geographic distribution of samples (for example by county) to reduce the chance of bias?

☐ Yes ☐ No ☐ Not Applicable

5.7. Does the State replace too-short or too short sample sections using a random process?

☐ Yes ☐ No ☐ Not Applicable

5.6 Data Quality Assessment

The answers provided in response to the checklist can be used to assess the level of agency's HPMS data quality, using **Table 5.2**. This assessment may help the State maintain or secure additional resources to address the issues identified to improve its

HPMS program. The assessment can provide useful information when discussing the State's program with the agency executives or with FHWA Division.

It is recommended that process reviews be conducted on these high priority areas as HPMS Program Activity Assessment scores warrant unless a schedule for improvement or change has been developed and is being implemented, or if any major deficiencies are identified that need timely resolution. An initial review may be necessary to establish a baseline for these activities, which later can be addressed individually or scheduled over several years.

Table 5.2. HPMS Data Quality Assessment Matrix

	Initial 0 point	Structured 10 points	Proficient 20 points	Score (points)
❶ LRS/GIS	• GIS/LRS is not adequately maintained and/or does not reflect the entire Federal Aid System. • On-Site LRS system is not tested and may contain overlaps and multipart features. • The state's LRS system is not integrated with ARNOLD. • There's no plan to rectify these issues.	• GIS/LRS is not adequately maintained and/or does not reflect the entire Federal Aid System. • On-Site LRS system has been tested and may contain overlaps and multipart features, but these issues have been identified. • The state's LRS system is not integrated with ARNOLD. • The state has a plan to rectify these issues, but not implemented.	• GIS/LRS is adequately maintained and reflects the entire Federal Aid System. • On-Site LRS system has been tested and does not contain overlaps and multipart features. • The state's LRS system is integrated with ARNOLD.	
❷ Quality Assurance	• QA/QC is not conducted before loading the data in the HPMS software using in-house or HPMS validation. • Field Inventory Review is not done or has been done more than a year ago. • Justification for data errors has not been added to HPMS submittal comments. • There are continuing errors each year. • There's no plan to rectify these issues.	• Basic QA/QC is conducted before loading the data in the HPMS software. The process is not documented. • Field Inventory Review has been done more than a year ago. • Justification for data errors has been added to HPMS submittal comments, but does not address all errors. • There are recurring errors each year, but the state is developing a plan to rectify them. Not implemented yet.	• Quality assurance program documented, funded, and no major data coding problems found. • Data QA/QC was done prior to loading in the HPMS software. • Field inventory review has been conducted within the past year. • Justification for data errors has been added to HPMS submittal comments, and they address all errors. • There are less recurring errors each year.	
❸ Traffic Data	• The state does not document or review its procedures for collecting traffic data. • The state does not follow FHWA and/or AASHTO procedures for data collection. • Other roadway sections, including ramps, are not counted on a six-year cycle. • VMT and growth rates are not checked for reasonableness before submittal.	• The state reviews its procedures for collecting traffic data, but there is no systematic, routine review in place. • Traffic data collection does not meet FHWA and AASHTO guidelines. • Current year data provided with acceptable statistical justification for anomalies and unusual trends locations. • Visual checks not conducted before submittal. • There is a plan to rectify these issues, but not implemented.	• The state reviews and documents its procedures for collecting traffic data. • Traffic data is collected according to FHWA and AASHTO guidelines. • Current year Traffic/Travel data provided for Federally Aided highways, and Local Roads (Summary). • Trends are consistent and the data is statistically accurate and precise.	

	Initial 0 point	Structured 10 points	Proficient 20 points	Score (points)
	• Visual checks are not performed. • There's no plan to rectify these issues.		• Visual checks are conducted before submittal.	
❹ Pavement Data	• Complete data provided, on-state system updated on an infrequent cycle, off-state system data incomplete. • Does not meet MAP-21/Fast Act based performance measure requirements, and there's no plan to rectify this issue. • Pavement data collection does not meet the specifications outlined in HPMS Field Manual. • There is no pavement data quality assurance plan in place. • Pavement data is not tied to the state's LRS system. • No plan to rectify these issues.	• Complete data provided, on-state system updated on a 2- or more year cycle. • Plan developed for complete off-state system data, but not implemented yet. • Does not fully meet MAP-21/FAST Act based performance measure requirements, but there is a plan to rectify this issue. • Pavement data collection may not fully meet the specifications outlined in HPMS Field Manual. • The pavement data quality assurance plan is not fully documented. • Pavement data is tied to the state's LRS system, or is not well-maintained. • There is a plan to rectify these issues, but not implemented.	• Complete data provided and collected in accordance with Field Manual, all current 1-2- year data, where required. • Fully meets the performance measure requirements as intended under MAP-21/FAST Act. • The appropriate pavement data items are being reported predominantly in 1/10th of a mile sections. • Pavement data is tied to the state's LRS system.	
❺ Sample Adequacy	• Many samples have not been developed where required (sample adequacy issue). • There are sample bias issues (including geographical distribution issues). • There are un-sampled, under-sampled, or oversampled volume groups • Many samples are not populated with the required sections data. • There is no plan to rectify these issues.	• An incomplete sample panel has been submitted, but the adequacy issues are minor. • Minor sample bias issues. • Limited un-sampled, under-sampled, or oversampled volume groups. • Limited number of samples are not populated with the required sections data. • There is a plan to rectify these issues, but not implemented.	• Sample revisions not needed or were made addressing all deficiencies and HPPI comments. • Samples are fully populated with required section data. • The State uses a random sample selection process, and there is no sample bias issue, especially on the middle functional systems where the State owns fewer of the roads. • No un-sampled, under-sampled, or oversampled volume groups.	
Total (Out of 100)				

Appendix A: Expert Task Panel Outreach Questions

Topic 1: HPMS Coordinator's Job and Authority

- How do you define success as an HPMS coordinator?

- What are the factors that influence an HPMS coordinator's success?

- What are the most significant challenges that HPMS coordinators face?

- HPMS Coordinator Qualifications?

    - Education

    - Experience

Topic 2: Documentation of Best Practices

- What should documentation accomplish?

- Do different levels make sense?

    - Organizational

        - Organizational Chart of the agency and the HPMS team

        - Personnel

        - Lines of authority and responsibility

        - Contact list

    - Processes

        - Timing/schedule

        - Data transfer

        - Software applications

Topic 3: Internal Conflict Resolution: Findings

- Should the agency establish clear lines of authority and include in the documentation?

- What's the level of authority for resolving conflicts?

    Should the agency establish Memorandum of Understanding (MOU) with internal partners?

Topic 4: Management and Coordination

- Should communications be documented?

- If so, what to include?

- Documentation of communications, meetings

- Identification of action items, responsibilities and follow up

- Identify need for corrective actions, documentation of follow up

Topic 5: External Partner – Data Best Practices

- Memorandum of Understanding (MOU)

- Participation in formal meetings

- Cost sharing

Topic 6: QA/QC Best Practices

- Documentation of conflict resolution, how, what, when, and why.

- In-field audits with districts/data providers

- Timely completion of internal audits

- In house software to create HPMS data

Appendix B: Uses of HPMS

HPMS – Why We Need It and What It Impacts

- The Highway Performance Monitoring System (HPMS) is the only official Federal government source of national level data on the extent, condition, performance, use, and operating characteristics of the nation's highways, established first in 1978. Given this, HPMS data are widely accepted and used throughout the transportation community, including other governmental entities, business and industry, institutions of higher learning for transportation research purposes, and the general public.

- HPMS data are used to support the following activities and programs:

  - Apportioning Federal-aid highway funds

  - Economic and travel forecasting

  - Freight Analysis Framework (FAF)

  - Highway Economic Requirements System (HERS) Model

  - Highway Safety Improvement Program (HSIP)

  - National, State and local transportation decision-making and trade-off analysis for statewide transportation planning purposes

  - Transportation Performance Management (TPM)

    - *Pavement Condition*
    - *System Performance, Freight, Congestion Mitigation & Air Quality Improvement Program (CMAQ)*

- HPMS also contributes largely to the following national products:

  - Biennial Conditions & Performance (C&P) Report to Congress

  - Annual Highway Statistics publication

  - Fatality rates and injury rates for NHSTA and FHWA

  - Other FHWA publications

- Program requirements

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- Primary requirement: State DOT-collected public roadway system condition and performance data/metrics for a given calendar year due to be submitted to FHWA by June 15th of the following year in accordance with 23 CFR, Part 460.3; <u>NOTE</u>: data will be required to be submitted to FHWA via multiple submissions due by April 15th and June 15th, beginning in 2019.

  o *Annual creation of HPMS data is a cooperative effort between State Departments of Transportation (DOTs) as the lead, local governments, and metropolitan planning organizations (MPOs) working in partnership to collect, assemble, and report the necessary information.*

    — *Secondary/related requirement: Public Road Mileage Certifications (via each States' Governor) due to be submitted to FHWA no later than June 1st of each year in accordance with 23 CFR, Part 460. 3*

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Appendix C: References

Federal Highway Administration (FHWA). December 2016. *Highway Performance Monitoring System Field Manual.* Washington, DC: Federal Highway Administration (FHWA), Office of Highway Policy Information (OHPI).

American Association of State Highway and Transportation Officials (AASHTO). 2013. *AASHTO Transportation Asset Management Guide: A Focus on Implementation.* Washington DC: American Association of State Highway and Transportation Officials (AASHTO).

American Association of State Highway and Transportation Officials (AASHTO). 2014. *AASHTO Transportation Systems Management and Operations (TSM&O) Guidance.* Washington DC: American Association of State Highway and Transportation Officials (AASHTO).

"Capability Maturity Frameworks for Transportation Systems Management and Operations (TSM&O) Program Areas." *FHWA Factsheet No. FHWA-HOP-16-031*, February 2016.

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