HIGHWAY SYSTEM PERFORMANCE MANAGEMENT-STATE OF PLAY IN THE USA

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ABSTRACT

The paper is written from the perspective of the State Departments of Transportation (DOT) and describes the evolution of highway system performance management in the United State from state strategic planning to state based performance metrics, to physical infrastructure asset management to performance management. Inherent in all these practices is the need for quality data. A case example of the Michigan DOT is presented. All states have been collecting and submitting data to the federal government on pavement and bridge condition for 50 years. Recent studies have identified issues with the comparability of the data .It is felt that nationally the three areas where performance metrics can most easily be collected in a comparable way are pavement smoothness and bridge condition on the National Highway System (about 4% of the total USA road miles that carries 40% of the total vehicle kilometers of travel); and total highway fatalities in each state. The state DOTs are committed to doing this and to fully explore other candidate measures for mobility and operations; highway related serious injuries; truck travel time reliability and speed on significant freight corridors and environmental measures. Observations on comparative benchmarking are offered for all PIARC countries.

1. INTRODUCTION

1.1. Paper Objective

The paper is written from the perspective of the State Departments of Transportation and is intended to describe the evolution of performance management in the United States. The USA's system of government is one in which the States retain the ultimate authority and responsibility for actions not granted to the federal government. For roadways, the ownership of the major roadways in America are with the states—they own and operate on average 20% of the nation's roadways, including the Interstate Highway System (these roads represent 1% of the 4 million miles of roads in the country and carry 24% of overall travel) and about 40% of commercial travel. The federal government's role has been one of funding about 40% of the total capital improvements thru the highway trust fund and regulation of the auto makers and commercial vehicles. There has been renewed interest in the notion of performance and accountability in government in general .The highway program is often viewed as the leader in this regard and the best example of good governance in general. Performance management is intended to build on what have been successful practices in the past.

1.2. Performance Management Defined

Performance management is a policy-directed, data-driven, performance-based business practice that links organizational goals and objectives to resources and results. The outcomes of performance-based management include more efficient distribution of limited resources and a focus on accountability of decision-making. Over the last 15 years, there has been a dramatic increase among state departments of transportation (DOT) in the use

of performance management principles to plan, prioritize, track, and improve the effectiveness of nearly all DOT functions to achieve the agencies' fundamental goals. Performance information helps to guide decisions about priorities and resource allocation for capital project delivery and internal agency management and operations. The trend towards states adopting performance management has been the result of several factors, including the demand for more accountability from government programs and agencies (both state and Federal), the pressure of scarce financial resources, and the recognition of best business practice. Many states simply started using a simple performance management system with the resources available to them and expanded, developed, and improved the system over time. [1]

A "performance management framework" has been developed to illustrate the basic performance management principles that can be integrated into all of the critical functions and operations of a transportation agency (Figure 1). Actually using performance to drive resource allocation (the fourth box in the framework), such as budgeting, project prioritization, or internal allocation of staff and funding, is the lynchpin of actual performance management.

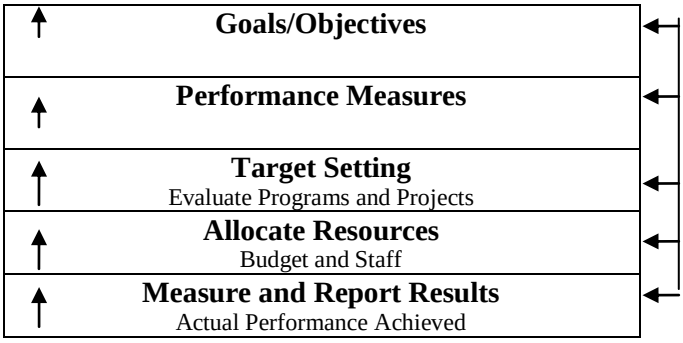

Figure 1 - Performance Management Framework

1.3. Why Important Now

It is very important now because of the scarcity of financial resources. There is a cry for greater transparency and accountability in government. The federal-aid highway program is up for reauthorization and everyone is saying that the program needs to become more performance based. AASHTO concurs in that assessment. More on this subject will be discussed in latest editions.

2. THE RELATIONSHIP BETWEEN ASSET MANAGEMENT AND PERFORMANCE MANAGEMENT

2.1. Overview

The basic principles of asset management and performance management are identical. [2] Good asset management must be performance-based and it remains one of the best examples of the application of broad performance management principles in the transportation industry. In fact, much of the initial work on defining the core principles of what now is called performance management were developed as part of AASHTO and

FHWA efforts to promote a strategic approach to asset management. Over the past few years, much progress has been made in extending performance management approaches to many aspects of the transportation system, beyond physical condition, and to a range of agency operations as well. However, the analytic tools, data, and experience in applying performance management principles are more advanced in asset management than in many other aspects of transportation. The AASHTO Subcommittee on Asset Management's new Strategic Plan (2011-2015) acknowledges the relationship between asset management and performance management and recognizes that a similar set of core principles apply to both activities.

While the core principles of asset management and performance management are identical, the application of these principles to different aspects of the transportation system will vary in terms of the appropriate performance measures, short-term versus long-term focus, the appropriate strategies for improving performance and the timeframe for being able to observe performance changes.

The best way to define the relationship between asset management and performance management is to recognize that broad performance management principles apply to asset management as well as other aspects of the transportation system and transportation organizations. Asset management refers to applying these principles to the management of transportation physical assets and provides a strategic approach for maintaining assets in a "state-of-good-repair".

2.2. Principles of Asset Management and Performance Management

The core principles of Asset Management and Performance Management are the same. Figure 2 shows the basic elements of performance management. At the broadest level, performance management is about linking agency goals and objectives with resources and results.

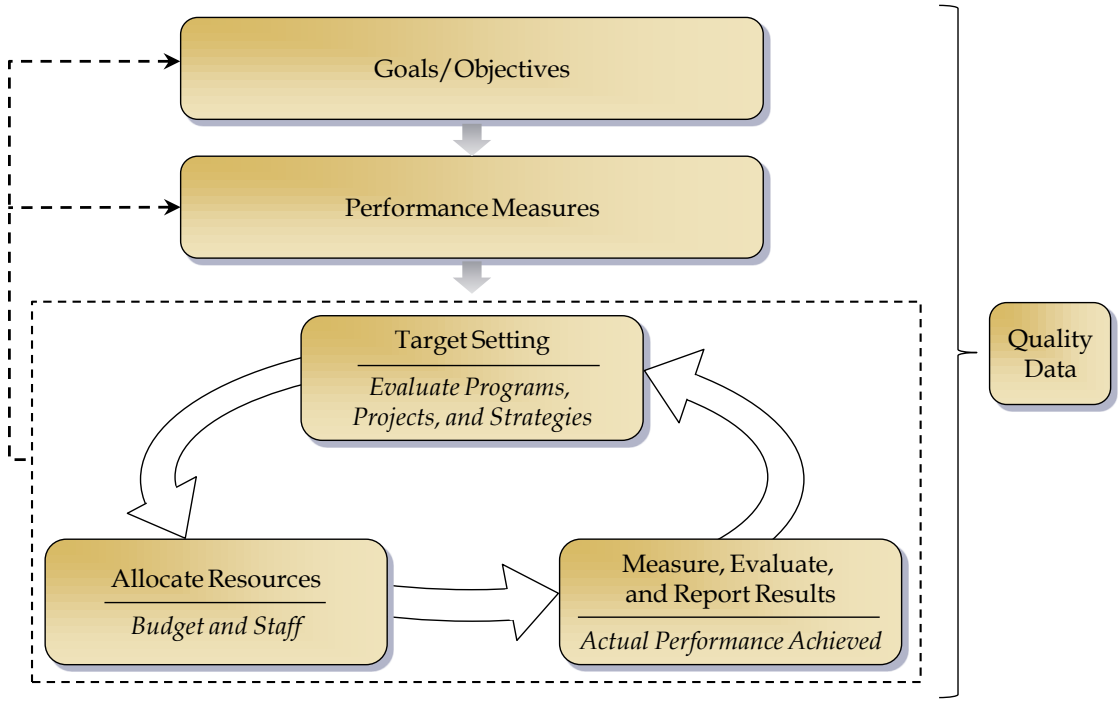

Figure 2 - Performance Management Framework Linking Goals/Objectives to Resource and Results

Each of these elements applies to asset management and performance management as discussed below:

Goals/Objectives – Resource allocation decisions are based on a well-defined and explicitly stated set of policy goals and objectives. In the case of asset management these goals would focus on the desired long-term condition of pavements, bridges, and other physical assets. In the case of performance management, goals also would focus on safety, operations, other aspects of system performance, as well as agency performance in areas such as project delivery.

Performance Measures – Policy objectives are translated into performance measures that are used for both day-to-day and strategic management. In the case of asset management measures would reflect the desired condition or health of physical assets such as pavements and bridges. Broader performance management measures might include travel time and delay, fatalities and serious injuries, as well as measure of agency performance such as on-time and on-budget project delivery.

Forecasting Performance and Target Setting – Decisions on how to allocate resources within and across different types of investments are based on an analysis of how different allocations will impact achievement of policy objectives and performance goals. For some goals, this may include forecasting the likely performance impacts of different strategies and setting performance targets. The limitations posed by realistic funding constraints must be reflected in the range of options and tradeoffs considered. For asset management a key issue is always the mix and timing of the right set of preservation strategies to minimize life-cycle cost while maintaining facilities in a state-of-good-repair. For congestion relief the issue might be the right mix of capital expansion and operations strategies to address bottlenecks given the funding available.

Resource Allocation Decisions Based on Quality Information – The merits of different options with respect to an agency's policy goals are evaluated using credible and current data. In the case of asset management, decision support tools, such as bridge and pavement management systems, are used to track system conditions and forecast performance in the future. For some other performance areas such as congestion relief and system reliability, data and tools are also available to evaluate likely performance results. However, for many aspects of performance there are gaps in both the data and the tools available.

Measuring, Evaluating and Reporting Performance Results – The actual performance impact of programs and projects are tracked over time and provide the basis for evaluating the most effective strategies to achieve desired goals. Recognizing realistic timeframes for observing performance results and understanding that these timeframes will vary by performance area is important. For example, for many key performance measures supporting asset management, changes in system performance will only be observable over a number of years. For some aspects of system operations or agency performance changes can be tracked on a monthly or even daily basis.

2.3. Strategic Resource Allocation Process

Understanding the strategic resource allocation process that agencies use to evaluate performance tradeoffs across all goal areas helps to integrate the two concepts of performance management and asset management. Figure 3 illustrates the strategic

resource allocation process. The performance areas (preservation, safety, etc.) shown are illustrative and may vary from agency to agency to some extent. [3]

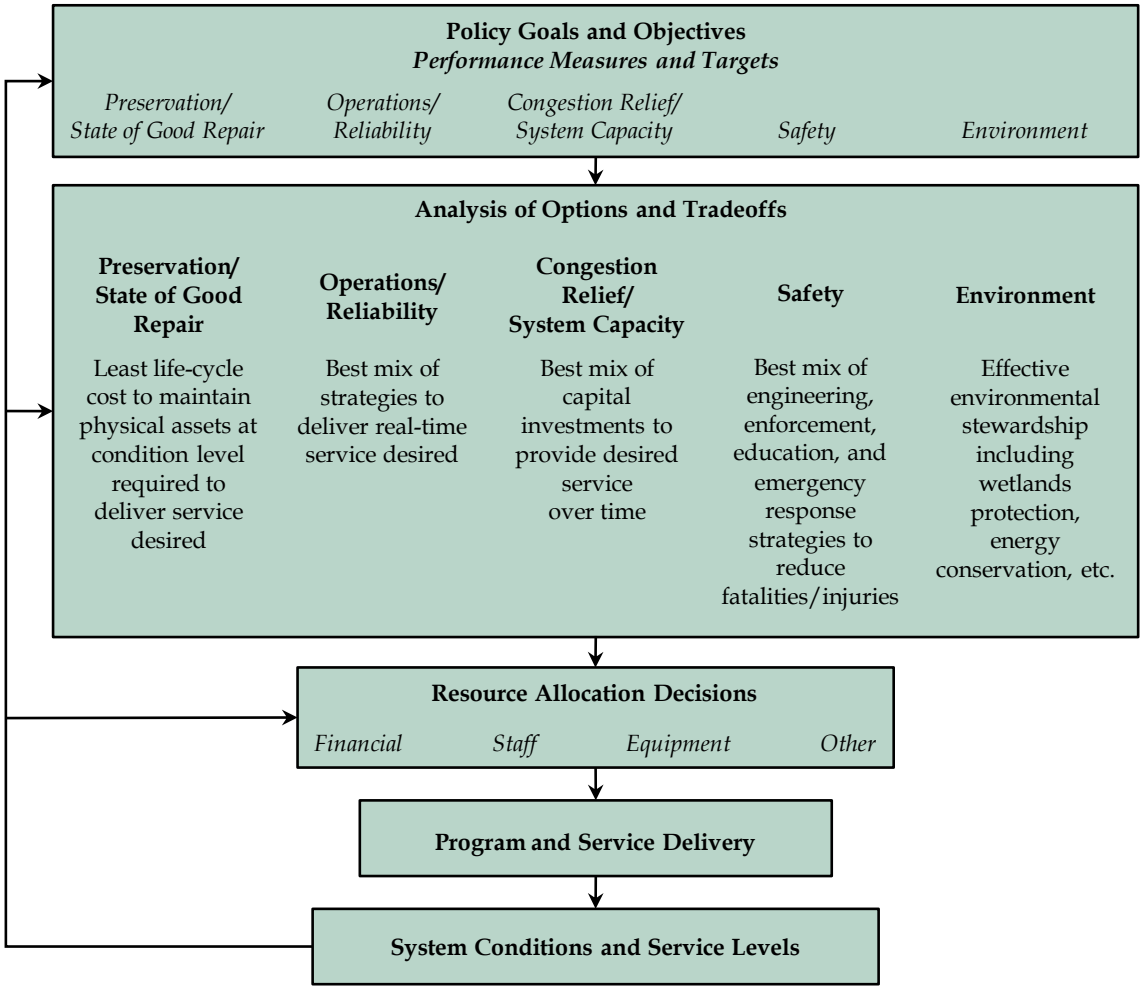

Figure 3 - Strategic Resource Allocation Process

Performance management principles apply to all the elements of this process while asset management refers to the application of these principles to the management of physical assets. This suggested way of looking at the relationship between asset management and performance management is not meant to imply that one is more important than the other. Both are essential in a well managed transportation agency and program. It is hard to imagine a comprehensive performance management strategy being very effective unless it includes a strong asset management component. Delivering on any important transportation system performance goal will require effective management and preservation of the physical assets needed to deliver that performance. These physical assets extend beyond bridges and pavement and include, for example, the facilities, equipment, and roadside features that support safety, traffic operations, and traveler information. These assets include lighting, signing, traffic signals, guard rails, median barriers, drainage, traffic management centers, incident response equipment and other facilities and equipment needed to manage, maintain and operate the system.

3. STATE OF THE PRACTICE AT THE STATE DOT LEVEL

3.1 Evolution of State of the Practice

State DOTS have been at the game for some time. In 2003 a report was issued that tied the evolution of performance measures of state dot strategic planning efforts. [3]

State Departments of Transportation are charged with ensuring cost effective design, construction, and operation of safe and efficient multimodal transportation systems that underpin the social and economic fabric of the communities they traverse, all while preserving or enhancing environmental quality. This is a complex mission!.

To help their agencies define and perform these challenging responsibilities, DOT Chief Executive Officers (CEOs) and senior management increasingly are turning to strategic management and performance measurement. These valuable business-planning toils are closely related, yet in many cases, they are not applied in a complementary manner.

By 2007, State DOTS had evolved into broader usage of performance measures as depicted in a primer on state dot performance management. [4]

All State DOTs track asset condition and safety data and the majority of states provide comprehensive performance data to decision makers to both increase accountability to customers, and achieve the best possible transportation system performance with current investment programs. The primary challenge for many agencies is the lack of funding to maintain and expand the current transportation system. However, by using a performance-based management approach, DOTs can maximize existing resources and justify recommendations for additional funding.

- Support Investment Decision Making. DOTS use department-wide performance measurement programs to allocate resources, support performance driven investment decisions and enhance internal agency management of programs

- Provide a Solid Foundation for State Wide Planning. DOTs have demonstrated that robust data and performance monitoring teamed with actionable goals and strategic business plans can be used to fine tune an organization and lay the ground work to achieve short-, medium- and long-range planning goals.

- Ensure Accountability and Responsiveness to Stakeholders. Performance measurement can assist in communicating how tax dollars have been spent, and/or whether more funding is needed. This also supports “customer focus” and improved public relations and stakeholder involvement.

- Support Quantification of Program Benefits. Infrastructure programs have a long history of documenting program impacts as embodied in pavement, bridge, and maintenance management systems.

- Meet Federal and State Legislative Mandates. In some states, the legislatures require transportation agencies to engage in a formal performance measurement and reporting process the federal government also requires certain transportation performance measures be reported by every state.

3.2. Michigan case example

The Michigan Department of Transportation (MDOT) has been using an asset management approach to investment in its infrastructure for nearly two decades. MDOT has also been working with local road agencies to help them do the same thing for almost ten years.

After the enactment of federal legislation Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), MDOT developed an organization-wide database designed to provide comprehensive and consistent data on MDOT assets. The intent was to have one database which could be used easily and routinely by decision-makers across the department, and it was strongly championed within the organization, even after the management system requirements of ISTEA were softened. Having that database helped further the asset management process at MDOT well before the initiation of GASB-34.

In 1999, Michigan's State Legislature created a task force to analyze transportation needs and funding. That task force learned a great deal about MDOT's asset management approach, which was already in place at the time. But the group's charge involved transportation needs and funding statewide, not just for MDOT. So one of the primary recommendations was that a "long-term planned asset management process be extended to statewide use for transportation facilities."

In 2002, acting on the recommendation of that 1999 task force, the Michigan State Legislature created the Transportation Asset Management Council to oversee the multi-jurisdictional data collection effort. Statewide asset management, implemented across jurisdictions, across agencies, with some kind of unified approach, was an ambitious idea at the time.

Today, the Transportation Asset Management Council oversees a comprehensive, unified data collection process at the state, county and city levels to assess the condition of Michigan's federal-aid eligible roads and bridges, and reports annually to the Legislature on the results. Their efforts allow all these transportation agencies to make highly informed decisions regarding investment in their road networks.

In order to give asset management an appropriate focus within the agency, MDOT created an Asset Management Division in the Bureau of Transportation Planning to coordinate activities statewide. Putting the division in Planning helped reinforce asset management in the approach used to develop and approve projects throughout the department. The division provides staff support to the Transportation Asset Management Council and handles data-related functions, such as traffic data collection and monitoring, pavement condition monitoring, and maintenance of the state's GIS base map and referencing system.

Asset management works best when linked to strategic goals and desired outcomes. In the late 1990s, Michigan's State Transportation Commission, which sets policy for MDOT's program, approved a set of condition goals for MDOT's highways and bridges:

95% of freeway pavements in good or fair condition by 2007
95% of freeway bridges in good condition or fair by 2008
85% of non-freeway pavements in good or fair condition by 2007
85% of non-freeway bridges in good or fair condition by 2008

The goals were clear, well-defined, and readily measurable. MDOT made investment decisions accordingly and achieved the condition goals on schedule. Since then, MDOT has developed additional goals that help expand performance measurement to other programs and other modes within the agency. Progress toward these goals is reported as often as quarterly in a web-based performance measurement report available to the public.

MDOT developed a series of educational materials on asset management early in the process, which have been widely shared over the past ten years by both print and electronic means. MDOT used National Highway Institute courses and some courses offered through Michigan's Local Technical Assistance Program (LTAP) to educate MDOT and local agency staff on implementing an asset management process within their organizations.

The goal of educating every employee on asset management was included in the department's 2006 Strategic Plan. The Asset Management Division developed an interactive electronic training program, designed to provide employees with the basics and details of the asset management process at MDOT. In recent years, the Asset Management Division produced one video presentation about asset management for roads and bridges and another on facilities. The interactive training program and videos were presented to the Transportation Asset Management Council, some of MDOT's external stakeholders, and members of the State Legislature. The program and video were also made available to the Legislature.

While asset management was initially seen as a way to stretch taxpayer dollars, it has also helped MDOT streamline operations and reduce administrative costs. Instead of being just one more thing on the "to do" list, asset management has become part of MDOT's organizational culture. MDOT works to incorporate data-driven decision-making and performance measurement as part of everything it does as an agency. Asset management is included in planning and policy documents, and the decision-making process is aligned to achieve asset management goals.

Data-driven decision-making and asset management can help agencies meet the ever-growing demand for transportation service in a fiscally constrained environment. And clearly defining the level of service or condition for different types of assets makes it possible to re-assess those levels of service or condition when resources fluctuate.

4. COMPARATIVE PERFORMANCE MEASURES

Transportation agencies are increasingly using performance measurement to solve complex management challenges. As performance measurement gains credibility among State DOTs, CEOs, their senior managers, and DIT technical staff are also growing more interested in learning from the performance of their peer agencies that share similar goals and objectives. Comparative performance measurement offers a way to compare DOT performance data on issues of strategic importance and share knowledge about best practices among agencies. State DOTs that outperform others can be identified and "best-in-class" practices or "lessons learned" can be transferred among agencies.

4.1. What is Comparative Performance Measurement?

What Is Comparative Performance Measurement? The premise of comparative performance measurement among DOTs is that independent agencies in different states often share similar strategic goals with their peers, such as smoother pavement or improved mobility, but in any grouping of peers, one or two agencies are likely to devise unique yet transferable business process that enable better performance in these areas. The benefits of using more cooperative performance measures include more communication among DOTs, greater awareness about best practices and innovations, improved business processes, superior performance, and increased responsiveness to customers needs. [5]

4.2. Studies That Have Been Done

There have been two studies done on project time and cost. [5], [6] These have truly shown the value of learning and sharing best practices.

For the highway system performance measures there have been studies done on pavement smoothness in 2008 [7]; safety in 2009 [8] and on bridges in 2010 [9] and on incident response in 2010-2011. [10]

For safety, this study highlights effective highway traffic safety practices associated with states that significantly "moved the needle" downward with respect to fatality rates in the first seven years of the 21st century. Looking at what these states have done has allowed for distillation of important practices from what is a highly complex and multifaceted endeavor. It has added to the existing body of information on best practices in safety, providing a snapshot of current practice, and a crystallization of important themes. Its results will add to a growing compendium of best practices for multiple important dimensions of state DOT practice.

The study did not yield dramatic new discoveries about how to reduce fatalities on the nations' highways. This is not surprising given the breadth of the topic and the level of resources that have already been devoted to analyzing fatality data and documenting best practices in safety. However, the study does provide a synthesis of important information that may not be well understood by state DOT managers who have not been actively involved in highway safety planning. Presenting this information in the context of comparative performance information provides a compelling basis for executives to quickly identify where they stand, see the potential for further improvement, and scan the key types of practices that can be explored for achieving that improvement.

4.3. Next Steps in Comparative Measures

The next steps are to take the results of comparability and to change the data collection methods of pavement roughness/smoothness and bridge condition to make all the state trend data comparable. In addition the concept will be continued on other performance areas such as serious injuries and congestion/operations—to get common definitions first and then learn from each other.

5. TOWARD A NATIONAL SET OF PERFORMANCE MEASURES

5.1. Introduction

Responding to the recent trends that placed greater emphasis on public-sector accountability for more effective performance the American Association of State Highway and Transportation Officials (AASHTO adopted a federal surface transportation authorization proposal that included a national performance measurement program focused on critical national goals. The proposal is based on the notion that a national performance measurement/management program would:

- Focus needed attention on key national goals;
- Provide more transparency and accountability for the federal program;
- Build on the considerable performance measurement/management work a
- Help make the case for larger federal program; and
- Drive better performance results through an iterative process of establishing best practices across states and determining which strategies are most effective in each particular goal area.

5.2. A Tiered Approach to Achieving A National Set Of Measures

AASHTO established task forces which have worked for nearly two years to identify performance measures that states could use to track the impact of investment in the national goal areas. [11] This effort has resulted in the designation of three tiers of performance measures for consideration in a national performance-based structure by which states would report annually their performance in these goal areas, using nationally-consistent measures relative to state-developed d targets for those measures. The measures in Table 1 Tier matrix were aligned against three criteria:

- Is there a general consensus on the definition of the measure?
- Is there a common or centralized approach to data collection in place?
- Has the availability of consistent data across states been established through national comparative analysis or other research effort?

Tier 2 measures meet all three criteria and are considered complete or nearly complete and ready for deployment, with the understanding that there could be further improvements to the measures in the future. Tier 2 measures meet one or two criteria and require further work before they are ready for deployment. Tier 3 measures are generally still in the proposal state and require further study and input from stakeholders in order to advance through the process of adoption. As some measures are currently more developed nationally, the level of detail for each measure varies. For some formulas are well established, but data issues must be overcome; for others data sources may be consistent, but field measurement varies.

Goal Area	Tier 1 – Ready for Deployment	Tier 2 – Additional Development Required	Tier 3 – Proposal State
Safety	5 year Moving Average of the state number of fatalities	5 year Moving Average of the state number of serious injuries	
Pavement Preservation	IRI on NHS	Structural adequacy on NHS	
Bridge Preservation	Deck area structurally deficient bridges on NHS		Structural adequacy of NHS bridges
Congestion /Operations		• Travel time based metric • Congestion cost • Reliability on the Interstate system	• Incident Management on NHS Routes: - Response time - Clearance time • Work zone closure
Environment		GHG emissions	Storm water runoff
Freight/ Economic Competitiveness	• Speed/travel time on significant freight corridors • Reliability on SFC's		Rural highway accessibility
Livability			*Definition to be identified and draft measures proposed*
Connectivity			*TBD in Future Work*

5.3. Performance Based Planning and Programming

There is a clear need for State DOTs to work with local governments to achieve overall improvement in the performance of transportation systems. This is particularly true for the broader measures such as safety and operations and the environment. Even for asset preservation of the national highway system, local planning agencies (—the metropolitan planning organizations (MPO's) in areas above 50,000 population; and for some states there are sub-state regional rural planning authorities), which influence the capital projects programmed on the NHS in the short-term as well as the performance goals for the regions. For this reason AASHTO (The state DOTs) are reaching out to many entities to define the planning and programming process acceptable to the majority. [12]

5.4. Federal Legislative Mandates

It is clear that when the US Congress reauthorizes the federal-aid highway program there will be legislative mandates for performance metrics to be compiled by the state dots. AASHTO has recommended a process to the congress that is fairly consistent with what the president has recommended.

In the USA, it appears that the areas of safety and state of good repair of road bridge and transit assets might be defined in federal law and for other areas such as the environment/livability/ congestion/mobility/accessibility, there needs to be more of a collaborative process with all the sub-national units of government and transit properties as well as highway agencies. [13]

6. CLOSING OBSERVATIONS FOR THE OTHER PIARC COUNTRIES BASED ON THE EXPERIENCES LEANED IN THE US

Based on the experience in the USA, we would recommend that as nations embark on developing high level performance metrics for use by the road authorities and transport ministers for showing accountability to the public as well as to legislators/parliament, they consider the following:

- Start with asset management measures for pavement and bridges and roadside safety and traffic hardware—physical infrastructure—important because your employees/ the public and those who fund the agency all see this as critical to your accountability.
- Think a small number of areas that you might have national goals or targets for—highway fatalities are a good example—the movement towards zero is a great aspirational goal.
- Solid comparative data is key.
- It takes a long time to get it right—after 50 years of the states producing roughness pavement performance data now that comparisons may be made they are leaning towards comparability in the way the data are collected.
- Work with sub-national partners and partners at the national level in such areas as safety and the environment and commerce—transport is only one player.
- Keep a focus on performance management---what gets measured gets addressed ultimately.

The next four year cycle will have this as an area that a technical committee will address—the USA will stay involved to learn from other nations and to share our experiences.

REFERENCES

1. American Association of State Highway and Transportation Officials (2011) "*A CFO'S Handbook on Performance Management*" https://bookstore.transportation.org/free_publications.aspx?ItemID=1769
2. American Association of State Highway and Transportation Officials, (April 2011) "*The Relationship Between Asset Management and Performance Management.*
3. NCHRP Project 20-24(20) Final Report (Aug 2003) *"Strategic Performance Measures For State Departments Of Transportation, A Handbook For CEOs And Executives"* https://bookstore.transportation.org/item_details.aspx?ID=285
4. AASHTO July, 2007 *"State DOT Performance Management Programs: Select Examples",* https://bookstore.transportation.org/free_publications.aspx?ItemID=10652007
5. AASHTO March 2006 "*Measuring Performance Among State DOTs "*
6. NCHRP Report 20-24 (37) A [01] Final Report (April 2011*)"MEASURING PERFORMANCE AMONG STATE DOTS: SHARING BEST PRACTICES-CONSTRUCTION SCHEDULE AND BUDGET PERFORMANCE UPDATE*"
7. AASHTO 2008 "*Comparative Performance Measurement -Pavement Smoothness"*
8. AASHTO 2009 "*Comparative Performance Measurement -Safety"*
9. NCHRP Report 20-24 (37) E Final Report (Aug 2010) *"MEASURING PERFORMANCE AMONG STATE DOTS: SHARING BEST PRACTICES-COMPARATIVE ANALYSIS OF BRIDGE CONDITION*"
10. NCHRP Report 20-24 (37) D [Completed] *"Measuring Performance Among State DOTs, Sharing Best Practices – Operations Performance Using Incident Response" [NCHRP 20-24(37)* Measuring Performance Among State DOTs : Sharing Good Practices]
11. NCHRP Report 20-24 (37) G (April 8, 2011*) "Technical Guidance For Deploying National Level Performance Measurements*"
12. Cambridge Systematics *National forum on Performance-Based Planning and Programming* summary report
13. The Federal Highway Administration budget estimates for 2010. http://www.dot.gov/budget/2012/budgetestimates/fhwa.pdf