SHRP2
STRATEGIC HIGHWAY RESEARCH PROGRAM

PROJECT BRIEF C02 MAY 2009

Capacity Project C02: Performance Measurement Framework for Highway Capacity Decision Making

This document summarizes the findings of SHRP 2 Capacity project C02. The final report from this project will include targeted case studies and specify data investments that can yield valuable returns. The framework being developed in this project will be made available as a web tool, which will include case studies and will be updated as additional SHRP 2 Capacity research projects are completed. The Responsible Staff Officer for this project is Steve Andrle, who can be contacted at sandrle@nas.edu.

Transportation agencies have used performance measures since the 1950s, but most of the advancements in performance measures have occurred in the last two decades. These advancements were largely fueled by demand from the public and elected officials for increased accountability in the decision-making process. The decision-making environment has become more complex as a result, and it could benefit from more structure and organization.

Currently, only a few state departments of transportation (DOTs) and metropolitan planning organizations (MPOs) have begun transitioning to a full-fledged measurement approach to decision making. However, as the budgetary pressures on transportation agencies continue to grow, it seems likely that the use of performance-based decision-making systems will increase. The performance measurement framework being developed in project C02 provides an opportunity to improve the consistency of decision making by organizing a set of performance measures that are linked to each stage of the planning and development process.

Intended Users

The primary users of the performance measurement framework would likely be transportation agencies such as DOTs and MPOs, though the framework could also be used by counties and cities, as well as by natural resource agencies and land-use permitting agencies.

Objectives

The researchers for this project focused on meeting three key objectives. The objectives are to:

1. Develop a framework to implement performance measurement in all stages of project development—from long-range planning to environmental review;
2. Systematically integrate environmental, economic, and community con-

siderations into the analysis of highway expansion; and

3. Support the collaborative decision-making framework (CDMF) that is being developed by Capacity project C01's researchers.

Research Approach and Relevant Trends

To develop the performance measurement framework, the researchers reviewed literature on performance measurement, focusing on areas such as the environment, community, and economics; interviewed transportation agencies to determine the extent to which they are using performance measures; and targeted case studies to identify performance measures and applications at various agencies. They also examined other frameworks, such as the Florida DOT's Performance Measures Framework. During the research, several trends and themes in performance measurement became evident. Some of the trends that relate to performance measures in general are listed here.

Table 1: SHRP 2 C02 Performance Factors

Transportation
Mobility
Reliability
Accessibility
Safety
Environment
Ecosystems, Habitat, and Biodiversity
Water Quality
Wetlands
Air Quality
Climate Change
Environmental Health
Economics
Economic Impact
Economic Development
Community
Land Use
Archeological and Cultural Resources
Social and Environmental Justice
Cost
Cost
Cost Effectiveness

The researchers determined that performance measures are best identified in response to goals and objectives, not the other way around. They also determined that input (e.g., time, capital, resources), output (e.g., speed, throughput, congestion), and outcomes to the community and the environment should be included.

It is the researchers' opinion that excessive and redundant measures can overwhelm the end user and obscure key drivers of service quality. In the broadest sense, performance measures should determine if a transportation project will meet the goals of the transportation agency and if the project will significantly impact the environment or any communities. It is also important to establish early warning mechanisms that can identify anything that might derail a project before significant resources are invested. These broad questions can be informed by different types of data, but to be useful to decision makers, the answers must be basic.

All of the state DOTs and MPOs interviewed during the research cited limited federal and state funding as a key constraint on prioritization efforts for capacity enhancement projects. Each interview emphasized that more funding is allocated for projects that preserve aging infrastructure than for those that add highway capacity. Capacity-adding roadway projects are typically the focus of increased scrutiny due to the great cost and physical impact of these projects. For both state DOTs and MPOs, the critical driver of implementing a performance-based system is using data-driven decision processes to support improved decision making and accountability within the organizations and, ultimately, to improve transportation system performance through better project selection.

Performance Factors

The performance measures developed in this project are organized around five broad factors, which are displayed in table 1. Some of the trends found during the research in each of these factors are noted here. The full report explains each of the factors in detail, as well as gaps in the data and possible methods of filling the gaps.

Transportation Factors

In recent years, shifts have been found in transportation performance factors. The literature has shown that the performance measurement of transportation systems has become increasingly operations-oriented. A trend to measure how customers experience the transportation system has also emerged from both the literature and feedback from practitioners. Travel time reliability has also grown in importance as just-in-time production and delivery methods increase in popularity.

Environmental Factors

According to the background literature, prior to the 1970s the environmental effects of transportation projects were investigated but not heavily weighted in decision making. This changed with the 1969 National Environmental Policy Act that advanced the state of the practice by requiring environmental review of all federal actions, including transportation improvements, but some DOTs admit that they are not as advanced in the field as they would like to be. However, DOTs are working with partners to better address environmental issues through the transportation planning and project development process. One such effort is *Ecological: An Ecosystem Approach to Developing Infrastructure Projects*, which was developed by eight federal agencies in cooperation with

four state transportation agencies.

Economic Factors

Economic trends indicate that there is an increasing demand for transportation. And according to the literature, it is important to consider the economic costs and benefits that potential transportation projects can have in order to maximize the positive outcomes. It is also important to note that determining whether a project is worth the resources that would be invested in it and how the benefits and costs would be distributed throughout the economy are two distinct but complementary analyses, and when determining the economic impacts, the decision makers should be careful to discern net economic growth from redistribution of wealth. Ideally, analyses could be conducted after a project is complete to gauge the accuracy of the predicted costs and benefits.

Community Factors

Comprehensively assessing the effects of a proposed transportation project on a community is complex. There can be many different effects and a wide range of preferences and opinions. Literature has shown that community outreach is important, because something that may not appear critical to a transportation analyst may be crucial to a community. It is also important to keep the design flexible to achieve the goals of individual communities. The Federal Highway Administration recognized the importance of flexibility by publishing its *Flexibility in Highway Design* manual in 1997 and the American Association of State Highway and Transportation Officials followed suit by publishing *A Guide for Achieving Flexibility in Highway Design* in 2004.

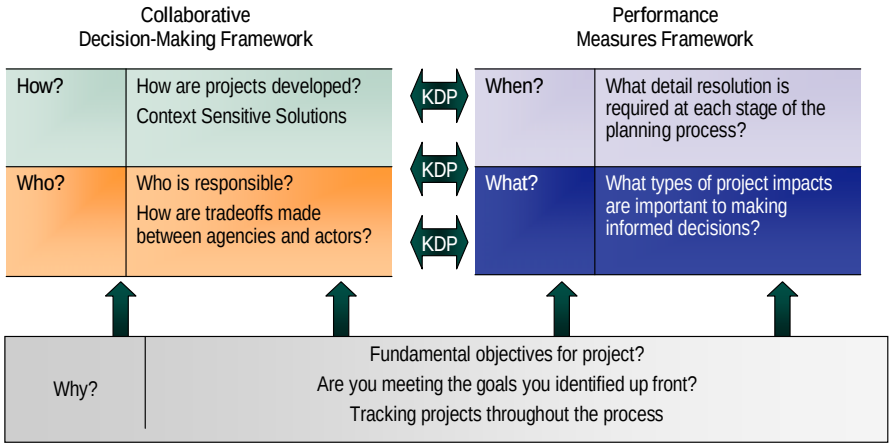
Cost Factors

It is important to consider project costs early and often. Project costs can escalate unexpectedly for a variety of reasons, some controllable and others unavoidable. It can be beneficial to monitor costs closely so that avoidable costs can be controlled and unavoidable costs can be identified early and accounted for in the budget. It is also important to consider possible opposition to a project before it occurs, because opposition to a project, regardless of its nature or merit, can significantly increase costs, including the cost of redesigning or abandoning a project after completing significant preliminary work.

The Framework

The performance measurement framework provides a variety of information that can be useful to many types of users within their organization. The primary purpose of the framework is to help practitioners find and define performance measures. It provides introductory material on a wide range of topics that can help educate all levels of transportation staff, e.g., practitioners with limited experience in ecosystem analysis can find key sources for information on the topic. It can also be used to develop a consistent evaluation process across several phases of transportation projects by providing information on how measures can be used at the various stages of planning and project development to support project identification and prioritization methodologies.

Figure 1: Relationship between Performance Measurement Framework and Collaborative Decision-Making Framework



From C02 Report: Performance Measurement Framework for Highway Capacity Decision Making

The framework being developed in project C02 will be made available as a web tool, which will include a database of the performance measures. This framework helps to support the CDMF by identifying relevant performance factors and measures to consider at the various stages of planning and project development. The CDMF being developed in project C01 identifies key decision points (KDPs), which are specific points in planning and project development that require consensus and formal approval. The relationship between the CDMF and the performance measurement framework is displayed in figure 1.

The performance measurement framework offers practitioners a way to organize how they use per-

Table 2: Example—Specific Objectives Used to Organize Performance Measures

SHRP 2 C02—Generic		Example—Specific	
Factor	Objective	Agency	Objective
Mobility	Reduce Recurring Congestion – Improve Travel Time	Arizona DOT—Long-Range Transportation Plan	Maintain and enhance the ability of goods to move through and around urban areas with minimal delay.
Air Quality Climate Change *(Environment broadly)*	Reduce greenhouse gas emissions from transportation sources	Florida DOT—Florida Transportation Plan	Make transportation decisions that conserve and optimize nonrenewable resources and promote the use of renewable resources (materials, facilities, and sources of energy) and include strategies to decrease greenhouse gases and air pollutants.
Land Use	Integration of land use and transportation planning efforts	Oregon DOT—Oregon Transportation Plan	Support the sustainable development of land with a mix of uses and a range of densities, land use intensities, and transportation options in order to increase the efficiency of the transportation system. Support travel options that allow individuals to reduce vehicle use.

formance measures so they serve as an effective decision-support tool for examining when, where, and how to add highway capacity. To offer flexibility, the performance measures can be grouped two ways: (1) according to when in the project delivery process it would be most helpful or (2) according to the factor of the project delivery process to which it would be most helpful. The phases of the decision-making process in which the framework can be used include: long-range planning, programming, corridor studies, environmental review, and design and permitting.

The specific measures of the framework are designed to be broad enough to be adapted by any agency and the measures are intended to address at least one of the following two objectives: identification and prioritization of statewide capacity needs; and support for evaluation of project-level options. An example of how agencies could adapt the specific measures to suit their needs is displayed in table 2. When measures are selected, the following characteristics should be considered: the relevance it has to the decision-making process; how it should be incorporated into the project; the agency responsible for addressing each issue at each phase; the level of detail that is appropriate to each stage and measure; and the number of measures and associated information that would support performance-based decision making the most.

The C02 research was conducted and a report was prepared by the research team led by Hugh Louch of Cambridge Systematics, Inc. The other authors of this report are Virginia Smith Reeder of Cambridge Systematics, Inc. and Joe Crossett of High Street Consulting Group. They received support from Steve Pickrell, Erik Cempel, Tracy Clymer, Randall Halvorson, and Joanne Potter of Cambridge Systematics; Anna Williams and Tim Larson of Ross & Associates; and Frances Harrison of Spy Pond Partners.

The Technical Coordinating Committee for Capacity Research in SHRP 2 oversaw the conduct of the research that is the basis for this report and reviewed its findings. The co-chairs of the committee are **Neil J. Pedersen**, Maryland State Highway Administration, and **Mary Lynn Tischer**, Virginia Department of Transportation.

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