

**ESTABLISHING A FRAMEWORK
FOR TRANSIT AND RAIL PERFORMANCE MEASURES**

Prepared for:

Division of Transit and Rail
Colorado Department of Transportation

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APPENDIX LITERATURE REVIEW

I. INTRODUCTION

Background/Purpose

Across the country state departments of transportation and many other governmental entities, recognizing the challenges of the current (and anticipated) limitations of transportation funding, have been exploring the values of performance-based transportation planning programs. While the Colorado Department of Transportation (CDOT) has been making strides in this direction in recent years, the new leadership has placed an increased priority on performance-based planning.

Furthermore, as CDOT continues to embrace its function as a multi-modal agency, the Division of Transit and Rail (DTR) was relatively recently formed to specifically address the transit and rail modes. In order to ensure that planning for these modes will properly fit into the overall planning program, DTR chose to examine a framework for performance measures related to transit and rail as one of its early action items. DTR engaged Felsburg Holt & Ullevig (FHU) to facilitate the framework development process with the ultimate purpose of establishing a structure within which performance measures could be used to assist in developing policy, prioritizing investments in projects/programs, and measuring success of the Division in meeting its goals and objectives.

Process

The development of the performance measures framework was led by DTR staff, with review and vetting by the Transit and Rail Advisory Committee (TRAC). The development process focused on three key steps:

1. **Determining Goals and Objectives**

When the TRAC was initially formed, one of its first actions was to establish a Vision Statement for the Division of Transit and Rail. During the development of the performance measures framework the TRAC made some minor refinements to this policy statement, resulting in the following Vision Statement:

To preserve and enhance the quality of life and the efficient mobility of people and goods, throughout and beyond Colorado, through the development of safe, reliable, environmentally sensitive, economic, and customer-responsive transit and rail networks.

At the same time the Committee also identified a series of Vision Values (which could be described as a combination of goals and objectives). Since the TRAC had spent considerable effort in preparing both the Vision and the Values, it was decided to begin the framework discussion by building upon the previous work.

At the first facilitated TRAC meeting in October 2011, the Committee members were engaged in a review of the Vision Values to attain a clear understanding of what was intended with each Value and to group the Values into a common set of primary categories, thus setting the stage for the structural framework and candidate performance measures.

2. **Data Collection**

This step focused on a comprehensive literature review completed by DTR staff, followed by a presentation of the findings to the TRAC. This process provided reference materials detailing frameworks and performance measures in use by other agencies.

3. **Establish Framework and Develop Candidate Performance Measures**

The establishment of the framework and development of candidate performance measures was facilitated during six consecutive meetings of the TRAC, starting in November 2011 and ending in April 2012. This process was marked by a presentation of incremental draft portions of the framework developed by the consultant team and discussion by the TRAC to amend, clarify, and add to the framework.

The key elements resulting from this process are summarized below in Chapter II.

II. FRAMEWORK DEVELOPMENT

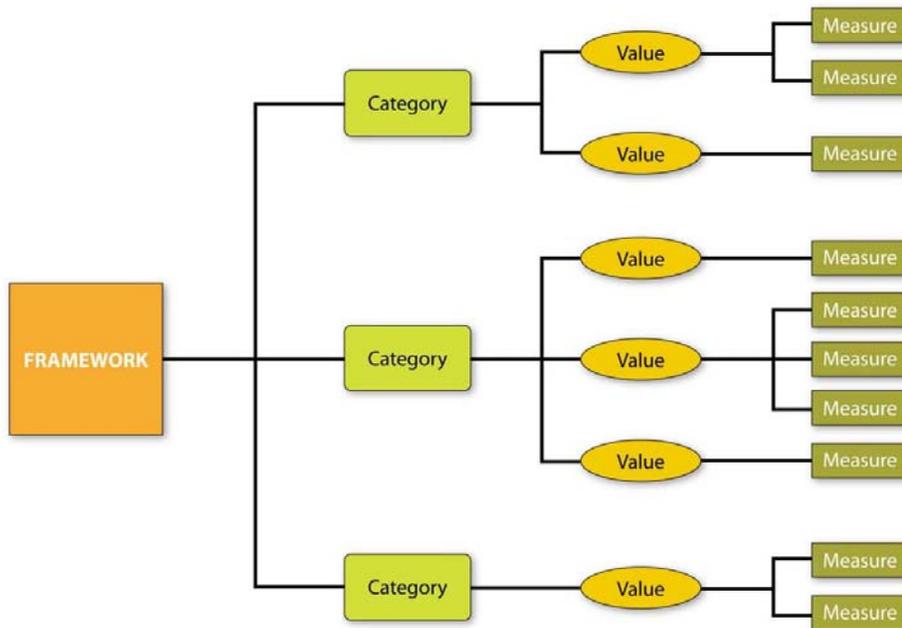
Literature Review

The comprehensive literature review completed by DTR staff identified relevant surveys and research reports defining in-practice performance measure framework approaches. Of particular interest during this review were recommendations for transit and rail facilities and the methods for developing statewide measures. The complete literature review has been provided in the **Appendix** to this report.

Two core concepts were identified as a result of the literature review:

1. **Category → Value → Performance Measure**

From an overview standpoint, *NCHRP Report 446, A Guidebook for Performance-Based Transportation Planning* does an excellent job of defining the relationship between the various elements of the performance measure framework in an organized structure. The hierarchal relationship between the categories, values, and performance measures is well illustrated by the following graphic.



CONCEPTUAL FRAMEWORK for PERFORMANCE MEASURES

Based on information from *NCHRP Report 446*, the following definitions of each of the elements have been crafted:

- **Category:** Categories serve at the highest level within the performance measures framework, and they provide a solid, broad basis for a performance-based planning process. These categories serve as the primary tenets of the performance measures framework. In this effort, seven categories have been adopted, including: accessibility, mobility, safety, economic development, environmental and resource conservation, efficiency, and system preservation and expansion.
- **Value:** A value is a general statement of a desired state or ideal function of a transportation system, for example “Coverage”, “Quality of Service”, or “Security”. Values define what aspect of a category will be addressed by individual performance measures within the framework, and may be defined by a single or many performance measures.
- **Performance Measure:** Performance measures demonstrate how well the transportation system is doing its job of meeting public goals and expectations of the transportation network. Measuring performance is a way to gauge the impacts of the decision-making process on the transportation system. These performance measures also aim to answer questions about whether the performance of the transportation system is getting better or worse over time, and whether transportation investments are correlated or linked to stated goals and outcomes.

2. **Characteristics of Good Performance Measures**

NCHRP Research Result Digest 361, State DOT Public Transportation Performance Measures: State of the Practice and Future Needs introduced five key characteristics of good performance measures. These characteristics were used during the framework development to ensure meaningful candidate performance measures.

Characteristics of Good Performance Measures

<p style="text-align: center;">Trackable Over Time</p> <p>Measures should be picked that can be consistently used over many years. The process for changing officially adopted performance measures can take significant time and effort to complete; consequently, consistency in measures is highly desired from an administrative perspective. DOTs also cite the value of consistently tracked data for making predictions and looking at impacts.</p>
<p style="text-align: center;">Storytelling Potential</p> <p>A related consideration for DOTs is selecting performance measures that are meaningful and can help weave a storyline around performance in the state. Performance measures can be an effective communication tool for the DOT overall and for reporting to the transportation commission and the state legislature.</p>
<p style="text-align: center;">Meaningful for Types of Service Measured</p> <p>Performance measures should be defined based on their ability to convey information about individual methods of transportation. Measures that are helpful when discussing transit may be different from freight rail, but still may have the same ultimate goal for describing the performance category and value. For example, safety is a category useful for all transportation types, but must be measured using unique performance measures (e.g. transit may be measured in injuries per million miles of service and freight rail may be measured in crashes per year at rail crossings statewide).</p>
<p style="text-align: center;">Relation to Statewide Public Transportation Goals</p> <p>In performance-based planning, performance measures should track progress toward an agency’s stated goals and objectives. The Transit and Rail Advisory Committee has already defined a vision statement and values and assigned each to individual categories. Performance measures identified for each category should be chosen based on their cohesion with these stated goals and objectives.</p>
<p style="text-align: center;">Available Data</p> <p>In many cases, the measures selected are heavily influenced by the availability of data. The available data will vary depending on the transportation type and performance measures should be oriented to available data or data that can reasonably be expected to be available as the performance measures framework is implemented. As most states do not directly operate transit and rail services, they rely on the data available from local public transportation providers and freight rail companies.</p>

Definition of Categories

NCHRP Report 446, *A Guidebook for Performance-Based Transportation Planning* was used as a starting point when determining appropriate categories for this performance measures framework. During discussions with DTR and the facilitation with the TRAC, the framework development process resulted in the selection of seven categories, described below.

Definition of Categories

Accessibility
Providing access to jobs, recreation, shopping, intermodal transfer points, and other land uses for all segments of the population is one of the primary purposes of any transportation system. Measures of accessibility reflect the ability of people and goods to access services, use different modes, and reach different destinations. Measures of accessibility also often capture the density of transportation service or land uses within a given area.
Mobility
Providing mobility is another fundamental function of transportation systems. Unlike accessibility, which reflects the ability of people or goods to reach destinations, mobility incorporates the relative ease or difficulty with which the trip is made. For example, a location may be accessible by transit but, if service is infrequent, transit-dependent travelers may still face restricted mobility. Likewise, congestion often impedes the mobility of private vehicle users; however, these users still enjoy excellent accessibility. Measures of mobility are often concerned with travel times, cost, speeds, system usage, and system capacities.
Safety
Safety is a state that we wish to enjoy while attaining other goals. Society wishes to remain safe while attaining mobility, productivity, and so forth. The safety measures are categorized by type of infrastructure (e.g., safety at rail crossings, safety in parking areas, and transit safety).
Economic Development
Economic development is frequently viewed as the underlying reason for providing transportation infrastructure. While the relationships between transportation investment and economic growth and productivity are complex, transportation systems are an unquestionable prerequisite for economic activity. Economic development measures are typically divided into those that measure the transportation system’s direct economic impacts (e.g., congestion costs) and those that measure the economic health and vitality that transportation supports (e.g., number of businesses with good transportation service).
Environmental and Resource Conservation
The conservation of environmental resources is a desired byproduct of transportation systems. Society wishes to foster mobility, accessibility, economic development, and quality of life through transportation while preserving environmental resources. Measures of environmental and resource conservation may be given in terms of resources saved (e.g., gallons of fuel conserved) or in terms of resources expended (e.g., tons of pollutants emitted).
Efficiency
Operational efficiency refers to the efficiency with which resources are used to produce a given level of transportation output. There are families of measures that reflect, for example, labor productivity or the operating efficiency of transit systems. Measures of operational efficiency are typically the concern of transportation system suppliers and are associated with system efficiency.
System Preservation and Expansion
System preservation refers to the physical condition of transportation infrastructure and equipment. System preservation measures the condition of the system itself (e.g., age of transit fleet, cost to maintain railways). System expansion identifies a future goal of continuing to expand the transit and rail system throughout the state as economic conditions allow.



Connecting Vision Values to Categories

As noted earlier, one of the first steps of the TRAC meeting facilitation process involved linking the TRAC Vision Values to the general categories. This process was accomplished through a work session with the TRAC, during which each of the Vision Values was discussed, refined and assigned to the appropriate category. The following table summarizes how the Vision Values were assigned to each of the categories by the TRAC.

Assignment of Vision Values to Categories

Accessibility
<ul style="list-style-type: none"> • To serve the entire state, recognizing mode may change (and transfer locations are important) • Provide transit opportunities for all populations • State-wide and nation-wide passenger and freight connections • Community access (local) improvement (connection to regional systems from the start/end point, requires a strong local system to get travelers to the regional system) • Include and expand passenger and freight rail
Mobility
<ul style="list-style-type: none"> • Provide transit opportunities for all populations (ease of access) • Seamless connectivity (ease of connections from passenger viewpoint) • State-wide and nation-wide passenger and freight connections • Reduce auto dependency • Travel-time, cost, frequency, competitiveness, and reliability (especially competitiveness) • Integrate regional connectivity in all transportation projects (accommodate other modes in projects) • Create passenger-friendly environment
Safety
<ul style="list-style-type: none"> • Safe
Economic Development
<ul style="list-style-type: none"> • Marketing consideration (educating the public about rail vs. truck vs. transit vs. auto) • Preserving potential intermodal hubs and right-of-way (focus on potential) • Economic development and vitality (Transit Oriented Development, impact of short lines and passenger rail on economy) • Include and expand passenger and freight rail
Environmental and Resource Conservation
<ul style="list-style-type: none"> • Economic and energy efficiency • Reduce auto dependency • Include and expand passenger and freight rail
Efficiency
<ul style="list-style-type: none"> • Thoughtful passenger and freight intermodalism • Economic and energy efficiency
System Preservation and Expansion
<ul style="list-style-type: none"> • Preserving existing infrastructure • Prepare and protect future infrastructure and right-of-way • Include and expand passenger and freight rail, with a focus on preservation and allowing expansion when economically feasible

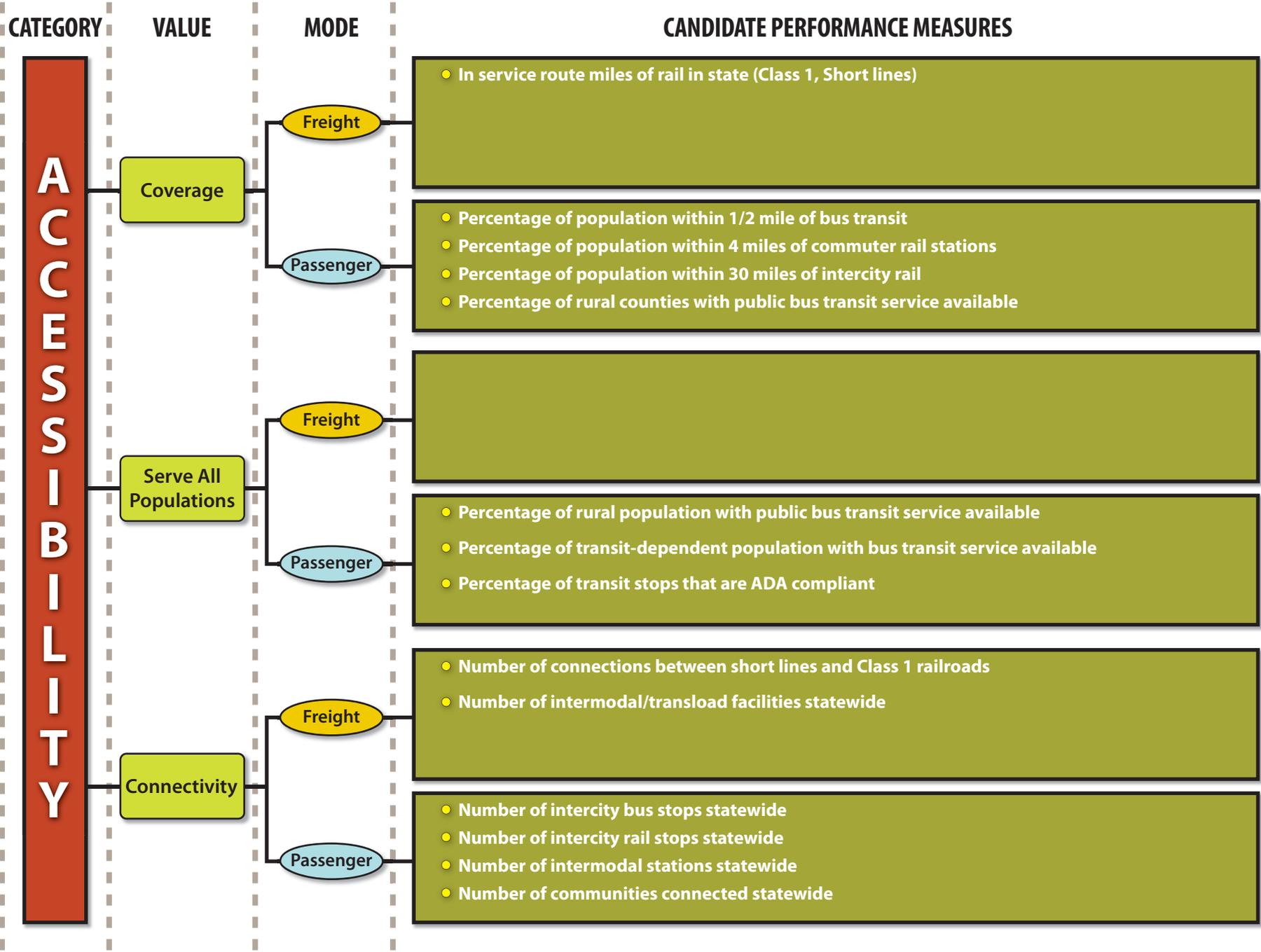
This discussion of the Vision Values revealed areas of overlap, gaps, and misunderstandings of the definition. Gaining a better understanding of the intent of each Vision Value was instrumental in helping the team in establishing the values used in the framework, which were often a consolidation or redefinition of numerous Vision Values. Also instrumental in the identification of values in the framework was information from the literature review process. These draft values were provided to the TRAC at each meeting, and the Committee was given an opportunity to amend, clarify, and add to the values.

Identification of Candidate Performance Measures

As values were established within each category, candidate performance measures were also suggested, debated and refined by the TRAC. It should be noted that the appropriateness of performance measures can vary significantly depending on the use of the measure and its intended target market. For the purpose of this exercise, the candidate performance measures that were identified were intended to be at a high level. The group focused on measures that would be useful in establishing the existing condition of the transit and rail systems at a statewide level and in assessing improvement in the state over time.

It should also be noted that the Committee recognized that in many cases performance measures would differ for passenger and freight modes. Hence, in the framework, subsets of candidate performance measures were suggested for these two modes.

The following figures depict the performance measure framework, which includes a separate figure for each category, identifying appropriate values and candidate performance measures.



CATEGORY

VALUE

MODE

CANDIDATE PERFORMANCE MEASURES

**M
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Quality of Service

Freight

- Percentage of rail with 286,000 pound capacity

Passenger

- Frequency – Number of bus transit trips daily (on a typical weekday, Saturday, Sunday)
- Frequency – Number of passenger rail trips daily (on a typical weekday, Saturday, Sunday)
- Frequency – Number of bus transit service hours daily (on a typical weekday, Saturday, Sunday)
- Frequency - Number of bus transit service days annually
- Connectivity – Number of timed-transfer stops between intercity bus transit and local bus transit service
- Connectivity – Number of timed-transfer stops between intercity passenger rail and local bus transit service
- Reliability – Percentage of bus transit trips on time
- Reliability – Percentage of passenger rail trips on time
- Percent of fleet with (wi-fi, on-board restrooms, highback seating)
- Percent of transit stations with (indoor waiting areas, vending machines, restrooms)
- Percent of agencies using real-time passenger information systems

System Use

Freight

- Total tonnage transported by rail (originating in Colorado, terminating in Colorado, intrastate (within state), overhead (traveling through state))

Passenger

- Total bus transit ridership in state (urban, rural)
- Total passenger rail ridership in state (urban, rural)

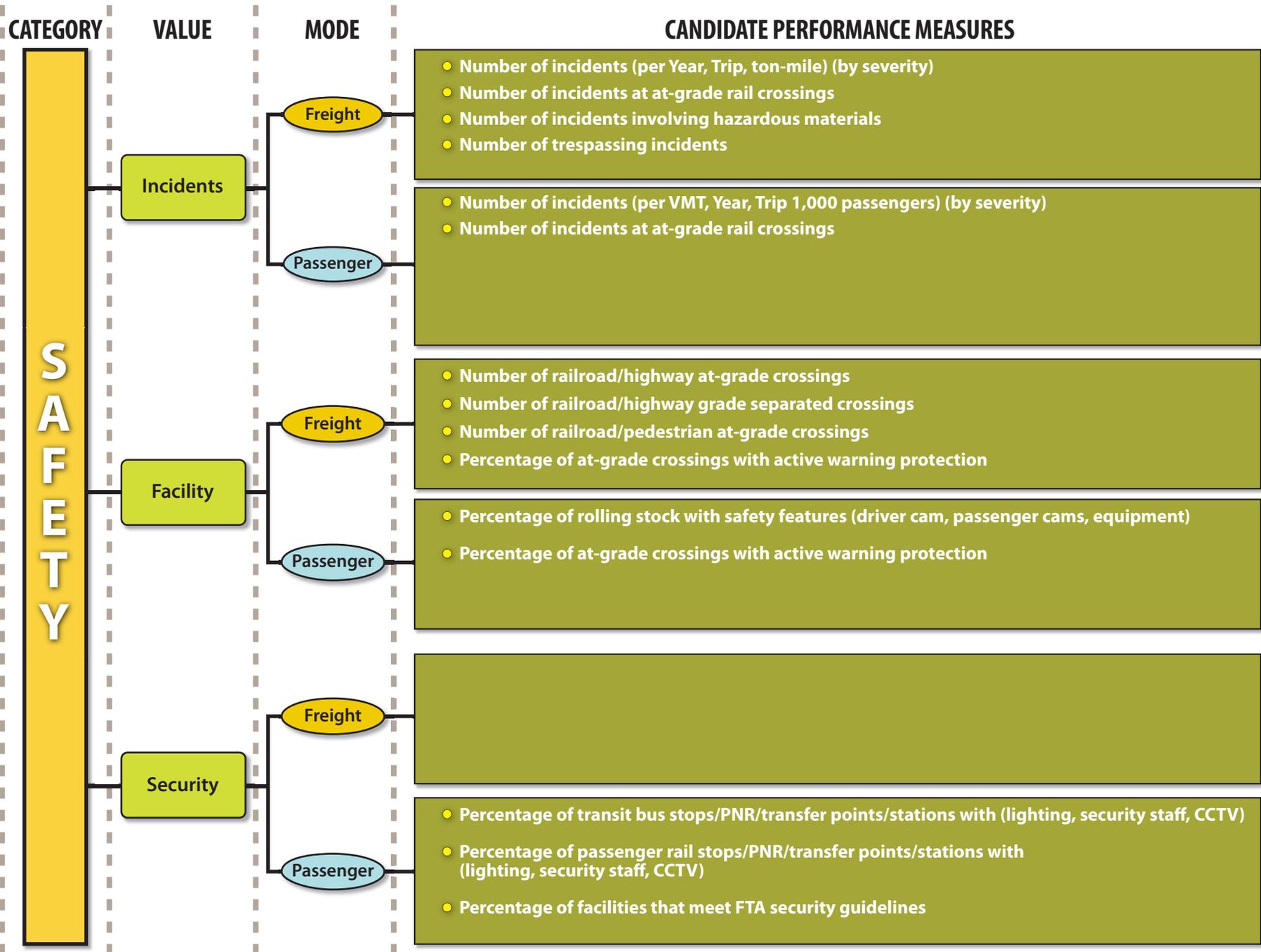
Mode Share

Freight

- Percentage of total tonnage transported by rail

Passenger

- Passenger-miles on bus (percentage or number)
- Passenger-miles on rail (percentage or number)



CATEGORY

VALUE

MODE

CANDIDATE PERFORMANCE MEASURES

ECONOMIC DEVELOPMENT

Employment

Freight

Passenger

- Workers employed by freight rail companies (Class 1, shortlines)
- Number of industrial spurs

- Workers employed by bus transit agencies
- Workers employed by passenger rail agencies
- Number/Percentage of jobs/businesses served by bus transit
- Number/Percentage of jobs/businesses served by passenger rail

Tourism

Freight

Passenger

[Empty box]

- Percentage of visitors who arrive/depart resort destinations by bus transit
- Percentage of visitors who arrive/depart resort destinations by passenger rail

CATEGORY

VALUE

MODE

CANDIDATE PERFORMANCE MEASURES

ENVIRONMENTAL CONSERVATION AND RESOURCE

Environmental Conservation

Freight

- Tons of pollution (or vehicle emissions) generated per ton hauled
- Fleet mix (Tier 2, Tier 3, Tier 4)
- Number of quiet zones statewide

Passenger

- Tons of pollution (or vehicle emissions) generated per 1000 riders
- Tons of surface contamination generated
- Number of rail quiet zones statewide

Resource Conservation

Freight

- Fuel consumption per ton-mile travelled

Passenger

- Fuel consumption per (VMT, PMT)
- Percent of fleet using alternative fuels
- Percent of maintenance facilities using alternative fuels
- Number of alternative fuel refilling stations
- Number of "green" facilities
- Percent of agencies with materials recycling programs

CATEGORY

VALUE

MODE

CANDIDATE PERFORMANCE MEASURES

EFFICIENCY

Financials

Freight

Passenger

Operations

Freight

Passenger

- Operating ratio

- Statewide fare box recovery
- Public cost per transit trip (subsidy)
- Cost per trip (or PMT, VMT, revenue-mile, passenger-mile)

- Average terminal dwell time
- Average train speed

- Revenue-hours per transit employee
- Passengers per (revenue-mile, revenue-hour)



CATEGORY

VALUE

MODE

CANDIDATE PERFORMANCE MEASURES

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System Preservation

Freight

- Miles of track classified as "Out of Service"
- Miles of track "Subject to Abandonment or Sale"
- Miles or percentage of total track (excepted track, Class 1, Class 2, Class 3, Class 4, Class 5, Class 6, Class 7, Class 8, Class 9)

Passenger

- Average age of transit fleet
- Average useful service life of fleet remaining
- Value of "State of Good Repair" backlog
- Number of agencies with transit asset management programs (fleet, buildings, equipment)

System Expansion

Freight

- Miles of track added in the last year (Class I, shortlines)
- Miles of right-of-way preserved for expansion
- Route miles of 286,000 lb capacity rail added
- Number of net new freight rail customers

Passenger

- Increase in bus transit route-miles (coverage)
- Increase in bus revenue miles (frequency)
- Increase in bus revenue-hours (frequency)
- Increase in rail transit route-miles (coverage)
- Increase in rail revenue miles (frequency)
- Increase in rail revenue-hours (frequency)

III. NEXT STEPS

The purpose of this planning effort has been to establish a framework within which performance measures could be developed to aid in planning, developing policy, prioritizing investments, and measuring progress of transit and rail programs in the state. The basic structure of categories, values and performance measures sets that framework, but there is considerable work ahead of the Division of Transit and Rail as it proceeds with expansion and refinement of the performance-based planning process and implementation of this tool. The following sections provide a brief discussion of the next steps.

Refinement of Performance Measures

As DTR continues with refinement of the performance measures, efforts should concentrate on three areas:

- **Research Data Sources** - As noted earlier, several key characteristics of a good performance measure are that data for measuring purposes are readily available and that the data will allow a measure to be tracked over time. Discussions with the TRAC have served as a preliminary screening process to eliminate measures with no known data sources or which are known to be too difficult to quantify on a regular basis. However, a next step should be to review these candidate measures by identifying the specific source of data for each measure and assessing the relative ease of compiling the data.
- **Consolidate Performance Measures** - The framework includes numerous candidate performance measures to serve as a starting point. A valuable next step would be for DTR staff and the TRAC to consolidate this list of measures to a manageable group of performance measures. This refinement of performance measures should be based on the ability to obtain the appropriate data and the relative value of the specific measure to the Division's current objectives.
- **Coordination with Other CDOT Entities** - As CDOT continues to develop its performance-based planning program, the performance measure framework for transit and rail will be integrated into similar efforts for all activities for which CDOT has responsibility. Therefore, as the Division moves ahead with this effort, it should continue to coordinate with the other CDOT entities involved in the evolution of the performance-based planning program. Although many of the specific performance measures may differ from mode to mode, the basic framework should be consistent across the Department.

Roles and Responsibilities for Implementation

An overarching need of the performance measures framework is to define how the framework will be maintained and measured into the future and who will be responsible for the various aspects of the process. Clear expectations must be established. Known roles and responsibilities that should be documented include, but are not limited to:

- Who will provide data for performance measure monitoring?
- Who will develop the techniques for performance measure monitoring?
- Who will measure and record the performance measure results?

- How will future additions/changes be incorporated into the framework?
- What will be the role of the TRAC in future performance measures decision-making?
- What other CDOT entities will have decision-making power with respect to this framework?

By clearly defining the roles and responsibilities for those involved with this framework, this process will maintain consistency with each review period and will develop a meaningful and transparent performance measures process.

Appendix

Literature Review

Establishing a Framework for Transit Performance Measures

Task 3: Data Collection - Literature Review

It is understood that the purpose of this literature review is twofold. First, there is a need to ascertain what performance measures are used elsewhere and how they may address the eight proposed categories of Accessibility, Mobility, Economic Development, Quality of Life, Environmental and Resource Conservation, Safety, Operational Efficiency, and System Preservation. Second, there is a need to identify performance data requirements and what resources are available.

This literature review was undertaken primarily by using resources available on the World Wide Web. The National Transportation Library's *Transportation Research Information Services Online* (TRIS Online) was utilized to find relevant resources. This search resulted in the identification of dozens of National Cooperative Highway Research Program (NCHRP) and Transit Cooperative Research Program (TCRP) Reports, Research Results Digests, and Syntheses, all of which are loosely relevant to the questions posed above. From the results of this initial search, DTR staff selected ten documents that appeared to hold the most promise for furthering the TRAC's discussions pertaining to the development of a performance measurement framework for the Division of Transit and Rail.

All of these documents are available for download or in the CDOT library if TRAC members would like to look further into the sources reviewed.

Summary of sources reviewed:

1). "Development and Application of Performance Measures for Rural Public Transportation Operators" TCRP Report No. 1338 (1992)

Purpose: Despite the increased interest in performance indicators for large transit systems, there has been no equivalent effort at establishing similar techniques for small and rural systems. This project developed a methodology to evaluate the relative performance of operators of rural transit service.

Applicability: This research and resulting methodology of measuring performance focused on rural providers in Texas. Although dated, it is applicable to the current effort, particularly as we move forward in developing discrete performance measures. The appeal of this paper lies in the fact that it is geared towards measuring performance at rural agencies. It also serves a role in setting the context for the history and evolution of this type of research, which is important to understand.

Methodology: The researchers undertook a literature review and conducted agency interviews.

Findings/Outcomes: It was found that agencies could be compared using measures of cost efficiency, cost-effectiveness, service utilization, vehicle utilization, quality of service, labor productivity, and accessibility. However, the findings indicate that more review of the statistics provided by the operators and greater communication between the operators and DOT staff would increase the usefulness of the performance measures. Most importantly, this early work identifies that QA/QC of agency submitted data is paramount when comparing performance among grantee agencies.

Source: A hardcopy of this document is available for review in the CDOT library.

2). TCRP Synthesis No. 6 "The Role of Performance-Based Measures in Allotting Funding For Transit Operations" (1994)

Purpose: This report of the Transportation Research Board examines the role of performance measurement in financing transit service. Specifically, the role of state government in assisting local transit service is discussed, as well as the challenges in the use of performance measurement.

Applicability: While dated, this synthesis is of particular interest to policy and planning personnel, and others concerned with the economic and budget aspects of providing transit service, as well as funding officials and policymakers in organizations such as departments of transportation (DOTs) and metropolitan planning organizations (MPOs). This synthesis explores current (1994) practice and trends regarding the linkages between financial assistance, service provision, and performance measurement. It also provides an overview of selected transit agency funding programs, as well as some information from state DOTs.

Methodology: This synthesis is largely based on a survey of selected state departments of transportation. A literature search was also conducted, as well as detailed follow-up discussions with a number of those responding to the survey. An expert panel was established to guide the researchers in organizing and evaluating the collected data, and to review the final synthesis report. In addition to this work, case studies were undertaken in order to explore the funding allocation systems used by three states -- Pennsylvania, Indiana, and Texas. These states were selected primarily because of the diversity of their approaches.

Findings/Outcomes: Key conclusions of this synthesis that may still be true in 2011 are as follows:

- There is often a lack of clear-cut goals established for public transportation in many states.
- Some funding organizations find themselves struggling with conflicts between their concerns for quality and quantity of transit service provided and the need to respond to legislative and taxpayer demands to constrain expenditures.
- There is widespread agreement among state departments of transportation and regional funding bodies like metropolitan planning organizations (MPOs) that local transit system performance should be tracked. Fewer agree that the results should guide financial subsidy decisions, and even fewer are doing it. Some of the related findings, candidly expressed by professionals in funding and recipient agencies, include the following:
 - It is difficult to reach consensus on what constitutes good performance, especially in light of the broad-based goals for transit funding assistance.
 - It is difficult to determine whether performance-based financial assistance should go to the good performers or the poor performers who may have greater financial needs.
 - Funding agency decision makers remain skeptical of the reliability of data provided by many local authorities and there is concern that information can be skewed deliberately or inadvertently to meet benchmarks.
 - There is doubt as to whether performance measurement systems can truly be sensitive to the differences among transit systems (for instance, small urban vs. rural); at the same time, external factors beyond the control of transit managers can also unbalance the playing field.
 - The influence of politics at state and local levels remains formidable, sometimes driving funding or operational decisions regardless of performance results.
 - Funding agency staff are reluctant to apply the financial penalties to local transit systems that might be dictated by performance-based decisions.
 - Performance-based funding may not respond appropriately to the competing pressures on public transit systems to take a hard-nosed business approach to service while also fulfilling their social mission.
- When performance components are used in subsidy allocation formulas, they tend to be combined with nonperformance factors or factors not traditionally viewed as performance characteristics, such as local financial contribution levels.
- Some state departments of transportation and MPOs have considered performance measurement and performance based allocation of financial aid. But they recognize that developing appropriate measures and allocation mechanisms that are responsive is no small task. At a minimum, it requires the active participation of transit systems and local and state legislative bodies.
- Almost all funding agencies maintain performance data on transit systems and use the information for program management and planning purposes exclusively or in connection with grant activities, as indicated above.

However, there is widespread feeling that allocations based strictly on performance measures result in inherent inequities.

Source: This document can be found online at: <http://onlinepubs.trb.org/onlinepubs/tcrp/tsyn06.pdf>

3). TCRP Report No. 6 “Users' Manual for Assessing Service-Delivery for Rural Passenger Transportation” (1995)

Purpose: This manual is meant to assist in designing public transportation services in communities where no systems now exist or in restructuring and improving existing rural transportation. The manual provides detailed methods that allow local planners and operators to identify and analyze transportation services in rural communities.

Applicability: This manual has limited applicability to the task at hand. However, it does include a good discussion on broad benchmarks that rural agencies can strive for as a relative measure of performance to their peers, and may be more helpful when the DTR performance measurement program is implemented.

Methodology: To achieve the project objective, the researchers conducted a comprehensive literature review of current practices. A survey of nearly 200 randomly selected rural public transportation operators, representing all rural public transportation systems in the country, was conducted. The survey collected detailed information on services consumed, services provided, operating and capital costs, sources of funds, and other relevant information.

Findings/Outcomes: A manual of recommended methods was developed using the research. The manual includes methods to decide which types and what levels of service to provide and highlights case studies of a variety of successful rural transit operations.

Source: This document can be found online at: http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_06-a.pdf

4). NCHRP Report Publication No. 446 “A Guidebook for Performance-Based Transportation Planning” (April, 1999)

Purpose: The purpose of this guidebook is to help organizations improve the development, implementation, and management of their transportation plans and programs. It is also anticipated to support transportation investment decisions tailored to the specific conditions and performance needs of major transportation systems.

Applicability: The research for this project was undertaken with an eye on identifying specific methods and practices that would be useful to a broad range of agencies and organizations undertaking performance based planning. This guidebook provides a structured approach to monitoring, evaluating, and considering transportation system performance in various components of the planning process. It also includes a "Performance Measures Library" (Appendix B) that catalogs measures currently being applied throughout the country. This report is relevant to DTR current effort, and has proven useful in “kick-starting” the development of the performance measures framework.

Methodology: The research undertaken for this report was based on a literature review and detailed case studies.

Findings/Outcomes: The general findings of this study were:

- Above all, integration of performance-based methods into the planning process remains a desirable and important objective.
- Implementation of performance-based planning methodology in the transportation planning context is an evolutionary process.
- In many instances, programs that started out comprehensive in nature have been refined to provide a smaller, more focused method of measuring system condition and performance.
- Performance measures are being applied in a variety of contexts

- The research findings do not warrant any endorsement for using performance measures as a way of replacing the current transportation project prioritization and selection processes with purely analytical, quantitative methods
- In most transportation agency applications, performance-based approaches have not yet had a significant impact on the ultimate outcome of decisions

There were several issues regarding implementation identified in this research, and two may be particularly valuable for the TRAC/DTR to keep in mind as we develop the framework for performance measures. They are:

- A performance-based planning process should include both performance measures which are broad enough to guide statewide system planning, and more specific measures that improve the ability of the agency to select and prioritize specific projects or programs at the regional or local level;
- While the use of more focused measures does lend itself to better informed planning decisions at the project and program level, it calls into question the importance of user-specific issues to those who are responsible for the entire transportation system.

Source: This document can be found online at: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_446.pdf

5). TCRP Report Publication No. 88: A Guidebook for Developing A Transit Performance-Measurement System (January, 2003)

Purpose: This guidebook was prepared with an eye on assisting transit system managers in the development of a performance-measurement system or program that uses traditional and nontraditional performance measures to address customer and community issues.

Applicability: This guidebook is oriented to transit agency's that operate fixed route and demand-response services, and not State DOT's. However, it provides a recommended set of core performance measures that can be tailored to different-sized agencies and some of these will be applicable to the TRAC's effort.

Methodology: The development of the guide book was undertaken through agency interviews. A total of 32 organizations were interviewed for the project about their performance measurement programs. These organizations included 22 transit agencies of various sizes (including two international agencies), a metropolitan planning organization (MPO), a regional transit authority providing financial oversight and planning for three transit agencies, a city, a private transit contractor, and six companies in the private sector.

Findings/Outcomes: The authors of this report recognize the differences between Fixed Route and Demand Response services, and recommend core performance measures, or categories of performance, specific to each. Recommended performance categories for Fixed Route systems are service availability, service delivery, safety and security, community impact, maintenance, financial performance, and agency administration. Recommended performance categories for Demand Response services are service coverage, span of service, service hours, revenue hours, and service denials. This research also suggests an important point - that transit agency's undertake the implementation of performance measurement systems for varying reasons (gauging customer satisfaction, internal reporting, etc.). Most importantly, it provides several good examples of how specific metrics might be tied back to the 8 proposed categories that the TRAC is currently exploring.

Source: This document can be found online at:
http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_report_88/Guidebook.pdf

6). NCHRP Project No. 20-24(20) – “Strategic Performance Measures for State Departments of Transportation: A Handbook for CEO's and Executives” (June, 2003)

Purpose: This project report is a guide for CEOs and senior managers in state DOTs on how to develop strategic performance measures.

Applicability: Since the target audiences are State DOT CEO's and senior executives, the report is relevant to the current effort to develop a framework for performance measurement.

Methodology: The research was undertaken through interviews of key personnel at State DOT's which have a proven track record in strategic performance measurement.

Findings/Outcomes: Strategic performance measures link together strategic planning and performance measurement to translate organizational vision into a small group of measurable, meaningful, and accurate performance measures. Only a handful of DOTs, however, fully integrate performance measurement with their strategic management efforts. They offer compelling evidence that performance measures are more than merely a way to track progress. Indeed, strategic performance measurement can be the catalyst for energizing strategic management efforts, maintaining focus, and enabling organizational change. The four key building blocks for establishing a strategic performance measurement program and reaping these benefits are: basic principles, criteria for measure selection, the choice of individual measures, and an implementation framework.

Source: This document can be found online at: <http://downloads.transportation.org/Quality-CEOHandbook.pdf>

7). TCRP (International Transit Studies Program) "Research Results Digest No. 95: Performance Measurement and Outcomes – a Report on the Spring 2009 Mission" (April, 2010)

Purpose: This study was undertaken with an eye on exploring how performance measurements are used to achieve organizational goals and enhance quality of service at public transport planning, funding, and operating agencies in Hong Kong, Special Administrative Region of the People's Republic of China; in the city-state of Singapore; in Kuala Lumpur, Malaysia; and in Taipei, Taiwan.

Applicability: One might ask why international research is relevant to an effort to develop performance measures at DTR. The answer is that transit systems, regardless of what country they are located in, have much in common with each other and with U.S. transit agencies. Quality of service, maintaining efficiency, safety, and accessibility, for example, are always challenges no matter the locale. Furthermore, and perhaps more importantly for this effort, it is recognized that funding agencies (such as CDOT) around the world are evaluating public transport agencies' or grantee performance when determining where to allocate public funds. This later point is where the rationale for reviewing this document resides.

Methodology: This paper is based on individual reports by the research team members who asked standard questions of the various agencies they studied.

Findings/Outcomes: The agency's that were surveyed had a clear difference in motivation than their American counterparts primarily because they are largely privatized and focus on business strategies that improve profitability. This report summarizes *how* performance measures are used, *why* they used or implemented, and *what* measures are being used at the subject agencies. All of the agencies surveyed identify broad "core" categories of performance (similar to what have been proposed for DTR) and then develop detailed performance measures that feed into one or more of the core categories.

Source: This document can be found online at: http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rrd_95.pdf

8). TCRP Report Publication No. 141 "A Methodology for Performance Measurement and Peer Comparison in the Public Transportation Industry" (2010)

Purpose: This research developed and tested a methodology for performance measurement and peer comparison for (a) all fixed-route components of a public transit system, (b) the motorbus mode specifically, and (c) major rail modes specifically (i.e., light rail, heavy rail, and commuter rail). This report complements *TCRP Report 88: A Guidebook for Developing a Transit Performance- Measurement System*, which describes how to implement and use performance measurement on an ongoing basis at a transit agency.

Applicability: TCRP Report No. 141 is an applicable resource in that it examines performance measurement and benchmarking as tools to (1) identify the strengths and weaknesses of an organization, (2) set goals or performance targets, and (3) identify best practices to improve performance. It is geared towards fixed route transit providers and has limited applicability to this phase of creating a framework for performance measurement at DTR. However, once the framework is finalized and the TRAC and DTR staff begin to identify specific performance metrics to be applied to the proposed performance categories, it will be quite useful as this document contains an Appendix that catalogs over 300 discrete performance measures.

Methodology: The research team undertook a literature review and selected agency interviews in an effort to identify comparison factors, performance measures, and applications. From this information an initial methodology was developed. Next, an interim report was prepared and presented to an expert panel for feedback and course correction. Once the methodology was modified, the team conducted small- and large-scale applications, and then interpreted the results, which are included in the final report.

Findings/Outcomes: As mentioned previously, this report is mainly geared toward agency's that operate fixed route public transit services. However, there are some findings that are applicable to State and Regional Transportation and Funding Agencies such as DTR. These are summarized below:

- **Issues with Reliability in Local transit agency and NTD data.** State and Regional Transportation and Funding Agencies should be familiar with local transit agencies and should know whether a change in a performance trend is due to something that has changed locally or whether it is a sign of a possible data problem. Some states, such as Texas and Florida, contract with universities to check NTD data and provide training in areas where data problems occur. In addition, for those state DOTs that incorporate performance results into grant-allocation formulas, having a data-checking process will help in obtaining transit agency acceptance that the data used by the distribution process are reliable.
- **Training efforts.** If the state DOT's review of its transit agencies finds that many are lagging their out-of-state peers in particular areas, the state can use this information to develop training activities in those areas that will benefit a large number of agencies.
- **Transit agency benchmarking programs.** The North Carolina DOT, for example, has developed a benchmarking guidebook for use by its state's transit agencies. This activity helps support the regional or state funder's goal of having its transit agencies serve riders efficiently and effectively and helps ensure that public money directly provided by the state is used responsibly. Funding agencies could consider providing incentives each year to local transit agencies that have developed and use such programs.
- **DOT annual reports on transit performance.** These reports can highlight performance-improvement success stories and the need for action in certain areas (such as dealing with aging infrastructure). These reports can also incorporate non-NTD measures that are of interest at a regional or state level, providing an additional information source that benefits all. The Washington State DOT's annual public transportation report is a good model.
- **Service area population and size values.** This research has shown the value of using per-capita performance measures and the desire of practitioners for reliable service area data. However, tracking regional population is not a normal transit agency function, and as a result the service area population and size values are not reported consistently to the NTD. MPOs, on the other hand, have the data and tools to readily perform these calculations.

Source: This document is available online at: http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_141.pdf

9). NCHRP Report Publication 708 – “A Guidebook for Sustainability Performance Measurement for Transportation Agencies” (July, 2011)

Purpose: The objective of this project was to develop a guide for state departments of transportation and other transportation agencies to use to measure the sustainability of their networks, systems, facilities, projects, and activities, at the appropriate scales, stages (long-range planning, programming, project development, design, construction, maintenance, operations), and time frames. The guide intended to (1) support agency decision-

making processes at various management levels; (2) enable agencies to develop appropriate sustainability goals, objectives and associated performance measures, and methods for conducting performance measurement and monitoring; and (3) describe computation methods for these measures and possible data sources.

Applicability: This guidebook is applicable to the TRAC and DTR's effort to develop a framework for performance measurement.

Methodology: Literature review, agency interviews, and expert panel review.

Findings/Outcomes: The report describes the underlying principles of sustainability as it relates to transportation, possible goals that can be used to address those principles, and performance measures that can be used to address those goals. It acknowledges that working with performance measures can be a daunting task due to the large number of possible measures, extensive data that might be required, and computational complexity—hence the need for identifying useful and easy-to-use performance measures. The report does contain a performance measures compendium, which is organized by sustainability objectives and applicable performance measures for each goal and focus area.

Source: This document can be found online at: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_708.pdf

10). NCHRP Research Results Digest No. 361 "State DOT Public Transportation Performance Measures: State of the Practice" (September, 2011)

Purpose: This Research Results Digest is intended to provide more information on performance measures and performance management approaches that can be used by state DOTs in relation to public transportation programs.

Applicability: This document is highly applicable to DTR's effort to create a framework for performance measures.

Methodology: The findings in this report are drawn from the three lines of research – 1) a literature review of state DOT performance management and public transportation performance measures, 2) a web survey of state DOT public transportation performance measures, and 3) interviews with selected state DOTs (Florida, Kansas, Minnesota, New Mexico, Virginia, and Washington) that serve as examples of the current practice in the use of public transportation performance measures at the state DOT level.

The research team conducted interviews by phone in October 2010. A copy of the questions is available, and information from the interviews is summarized in the report.

Findings/Outcomes: Through the survey, it was discovered that approximately two-thirds of all state DOTs indicated that they have some public transportation performance measures in place (30 out of 43 respondents). A number of motivations led these DOTs to the use of public transportation performance measures. These include providing accountability to stakeholders, responding to a legislative mandate, a desire for enhanced decision making, and as a way for agency leaders to communicate organizational priorities to their staff.

Common categories of measures include those that assess ridership, availability of services, internal cost and efficiency at the agency level, quality of service, asset management, and community impact. Findings indicate that ridership and internal cost and efficiency measures are much more widespread than measures of availability, service quality, asset management, or community impacts.

Use of performance measures by State DOT public transportation divisions is driven by the business functions these divisions perform, including compliance with data reporting requirements and supporting statewide public transportation planning decisions and funding allocation. Within the survey, 17 state DOTs indicated they are using public transportation performance measures to support allocation of or formulas for public transportation

operating funding, and 11 indicated they are using performance measures to support allocation of or formulas for capital funding. Several also identified that they were using performance measures to measure progress toward statewide goals (15 state DOTs) or for measuring progress toward agency targets or comparing agency services (15 state DOTs).

The research reveals that over half the states without public transportation performance measures indicated that data availability and lack of technical resources were challenges that have prevented the agency from using performance measures.

Among the best practices and lessons learned, several state DOTs emphasized the importance of picking measures that could be consistently used over many years – that is, they should be track-able over time. Others emphasized the importance of selecting measures that are meaningful to the storyline surrounding public transportation performance in the state. It was found that the type of service being measured affects what is considered meaningful. For example, rural public transportation systems must often look beyond traditional cost-efficiency measures to those that gauge social value and quality of life. Performance measures can also be used to track progress toward an agency's stated goals and objectives. Thirty state DOTs responding to the survey indicated that they have statewide public transportation goals in place, and 15 indicated they are using performance measures to track progress toward those goals. In developing measures, DOTs rely on various resources including their peer DOTs, their transit partners, and national-level documentation. Some DOTs are also developing partnerships with public transportation associations and universities to support data collection.

A number of challenges remain, however, for advancing public transportation performance measures at state DOTs. Collecting data and connecting performance to funding decisions are two key challenges. Many state DOTs pointed to a need to find ways to compare disparate public transportation systems and to collect accurate and relevant data from their public transportation providers. Moreover, developing appropriate performance measures is often challenging, given the disparate nature of different types of public transportation services, particularly in rural areas.

Source: http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rrd_361.pdf

Conclusions and Major Findings

There are a few broad points that can be taken away from this literature review that will be helpful as TRAC and DTR move through the process of developing the framework for public transit performance measures at CDOT:

- A key consideration is that since CDOT does not directly operate transit services, cooperation and coordination with public transportation providers will be critical to creating a useful statewide performance measurement program for public transportation.
- The research finds that many state DOTs are tracking public transportation performance measures for a variety of reasons, and it is important to understand the underpinning motivations when developing a performance measurement framework.
- Most performance measures in use focus on ridership and internal factors (e.g., cost, efficiency), though those that address service quality and asset management are becoming more widespread.
- Advanced public transportation performance measurement programs are notable for the linkages they make between organizational goals or strategy, performance measures used and funding decisions.
- Advanced public transportation performance measurement programs display characteristics such as accurate data collection processes, strong collaboration with public transportation providers, strong QA/QC practices, and sound reporting methods.
- Performance measures are most meaningful (and useful) when they are track-able over time, have storytelling potential, are meaningful for the different types of services being assessed, relate to Statewide goals, and utilize reliable and accurate data.

The research also indicates that there are potential challenges to be overcome during the process of creating a performance measurement program for public transportation at the DOT level. Challenges to be aware of include:

- Data updates, recording, and reporting. These tasks take time at the agency and DOT levels. We should strive to align these updates and reports with other update and reporting requirements – for instance when NTD data is “due” to be reported to the FTA.
- A lack of resources may exist at the local agency or DOT level. At the local level, this may be a lack of technical expertise or simply a lack of time to undertake the data collection efforts required by a performance measurement program. Depending on the ultimate magnitude of the performance measurement program, staff resources could become an issue at the DTR level.
- A diversity of providers/grantees can create challenges in selecting appropriate performance measures. These challenges often relate to differences in transit agency structure, funding, and governance that often exist between our rural and small urban systems.
- Change to a more performance oriented resource allocation method can often be difficult and face resistance.
- It can be difficult to link performance and expected outcomes to investment, particularly in the context of assessing “system wide” investment choices across all of a state DOT’s programs. A public transit performance measurement system for DTR should “fit” with other performance programs at CDOT.