MULTIMODAL FREIGHT PROJECT PRIORITIZATION

Final Report

SPR 759

Oregon Department of Transportation

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by

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16. Abstract

As available data has increased and as the national transportation funding bills have moved toward objective evaluation, departments of transportation (DOTs) throughout the country have begun to develop tools to measure the impacts of different projects. Increasingly, DOTs recognize the freight transportation system is necessarily multimodal. However, few DOTs have clearly stated objective tools to make multimodal freight project comparisons. This report informs that gap by summarizing the existing academic literature on the state of the science for freight project impact estimation and reviewing methods currently used by select DOTs nationwide. These methods are analyzed to identify common themes and determine potential avenues for multimodal project evaluation. Most methods either take the form of benefit-cost analysis or a scorecard approach. Examples of each were reviewed in-depth and patterns evaluated. While most tools use similar measures, the supporting metrics vary widely and are not applicable to all modes.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	millimeters squared	mm^2
ft^2	square feet	0.093	meters squared	m^2
yd^2	square yards	0.836	meters squared	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	kilometers squared	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	ml
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	meters cubed	m^3
yd^3	cubic yards	0.765	meters cubed	m^3
NOTE: Volumes greater than 1000 L shall be shown in m^3.				
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
		TEMPERATURE (exact)		
°F	Fahrenheit	(F-32)/1.8	Celsius	°C

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	millimeters squared	0.0016	square inches	in^2
m^2	meters squared	10.764	square feet	ft^2
m^2	meters squared	1.196	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	kilometers squared	0.386	square miles	mi^2
		VOLUME		
ml	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	meters cubed	35.315	cubic feet	ft^3
m^3	meters cubed	1.308	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams	1.102	short tons (2000 lb)	T
		TEMPERATURE (exact)		
°C	Celsius	1.8C+32	Fahrenheit	°F

*SI is the symbol for the International System of Measurement

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DISCLAIMER

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1.0 INTRODUCTION

Freight is an important component of any state economy. Accordingly, many state Departments of Transportation (DOTs) have been assessing their freight transportation system and the impact of freight transportation on state economic activity. There is increasing recognition of the fact that the freight transportation system is necessarily multimodal and may involve movements of shipments on waterways, airways and railways in addition to highways, which have been the traditional provenance of state DOTs. Thus, many state freight studies are carried out by multimodal divisions within the state DOT---which may also include multimodal passenger transportation.

In times of shrinking resources for investment as traditional sources of revenue are no longer plentiful, agencies nation-wide at all scales must be strategic with their projects. They must balance repairing or replacing failing facilities against providing on-going maintenance and tactical investments in new infrastructure. As available data has increased and as the national transportation funding bills have moved toward objective evaluation, DOTs throughout the country have been developing project prioritization schemes. Methodologically, these tools tend to either use a benefit-cost structure (sometimes implemented as a consumer surplus model) or an economic impact model. Benefit-cost analysis (BCA) models look to quantify specific costs and benefits of projects, attempting to itemize and measure each component. Economic impact models generally attempt to identify specific economic impacts in terms of job creation or trade inducement and frequently take the form of economic input-output models.

While DOTs are moving toward objective evaluation, they are also including freight into their planning and investment efforts as awareness of the economic impacts of freight mobility has increased and as the legislature has mandated its inclusion (*MAP-21* 2012). Early tools, BCA especially, focused on passenger travel and did not include freight explicitly. As part of the efforts to incorporate freight into the planning process, researchers have studied ways to include freight in BCA-type tools and some DOTs have begun addressing this gap by identifying the relevant measurements to include (*Cambridge Systematics et al. 2007a, Cambridge Systematics et al. 2007b*). The recent Transportation Investment Generating Economic Recovery (TIGER) grant application processes required a BCA, and a number of institutions provided guides or examples of how to work within this system, considering freight projects or using them as examples (*Adams and Marach 2012, OkDOT 2009*).

This report reviews methods currently used by select DOTs nationwide and summarizes the existing academic literature on the state of the science for incorporating freight into project prioritization. It then identifies nine methods for in-depth review and evaluates the limitations of the available methods. Finally, a set of suggestions for developing a multi-modal freight project prioritization methodology is presented.

2.0 SURVEY OF STATE DOT INVESTMENT PRIORITIZATION PROCESSES FOR FREIGHT

Multimodal tradeoff analysis is a topic of great interest, and many public agencies have expressed the desire to develop a process for incorporating multimodal analysis into their project prioritization process. In most cases, multimodal considers all transportation projects, not just those dealing with freight transportation.

In 2005, the FHWA held a workshop on multimodal tradeoffs (*FHWA 2005*) attended by representatives of various local, state and municipal DOTs (*FHWA 2005*). The FHWA and other meeting participants agreed that multimodal tradeoff analyses would be desirable for optimal resource allocation and assuring an efficient freight system. However, a lack of funding flexibility was noted as a major deterrent to using multimodal tradeoff analysis to achieve these goals.

For instance, the Denver Regional Council of Governments (DRCOG) mentioned that funds for different types of investment projects (say transit and highway) are from specific dedicated sources of funds and cannot be used for another mode. In other states, such as Maryland, the funds may be virtually all allocated from a general fund with few mode-restricted sources of funds. When funds are allocated to a specific mode it makes the question of intermodal allocation of funds to investment projects irrelevant.

Some states mention multimodal investment in their freight plan as a way to achieve an efficient statewide transportation system for freight whereas others (such as Florida) have tended to focus on freight critical corridors rather than the entire state system as a whole. Many government transportation agencies seem to have a system for prioritizing investment projects within a specific mode although some do it quantitatively whereas many use a more qualitative approach.

Many states have developed, or are developing, freight transportation plans. Most states have separate divisions for highway, waterway (marine or port), air (aviation), and rail transportation modes and, while one state may have a rail plan, it may not have an aviation plan or even a highway plan. In addition, the range of detail included in these plans varies significantly between states. Some plans just state basic goals of state transportation policy (such as safety, mobility, etc.) while other have detailed performance measures for each. Further, when it comes to investment decision making some states may have a very detailed investment prioritization plan for one mode of transport while the other modes in the state do not appear to have a well-developed plan.

When investment prioritization plans exist and are well developed, they appear to fall into two broad categories:

1. A scoring plan, or scorecard, with specific points given for different degrees of fulfillment of desired objectives, filled out by the evaluator, and

2. Ranking projects by measuring the net economic impact of the project(s).

The following section provides an overview of the methods various states use to prioritize investment projects for freight. The DOT state websites were searched for terms including *freight plans, long range plans, multimodal plans, investment* and *project prioritization*. The search did find some scorecard methods used or proposed for use as multimodal prioritization tools, although most were not devoted totally to freight. The states chosen for this in-depth review have state long range plans that mentioned multimodalism or have freight plans that acknowledged the importance of prioritizing long range multimodal projects for freight.

Notes from interviews with various state DOT staff are included in Appendix 1. Web site location for freight plans, multimodal plans, rail plan, highway/bridge plans, aviation plans and any prioritization documents found for each state, are listed in Appendix 2.

2.1 FLORIDA

In 2003, the state of Florida first defined the Strategic Intermodal System (SIS), a statewide network of high priority transportation systems throughout the state. The SIS includes high volume commercial airports, deepwater seaports, railway corridors and freight terminals, highways, and waterways. The SIS was developed to focus state resources on the transportation facilities most important for fostering Florida's economic competitiveness and quality of life. (*FLDOT 2010a*) Although both passenger and freight transportation services are provided over this system, it has significant components that just serve freight.

A SIS Multimodal Needs Plan was developed to identify the needs on the SIS for the next 20 years. FLDOT works with partners to identify freight projects of statewide significance that will enhance freight transportation to and from the state (both nationally and internationally) and within the state.

For prioritizing SIS projects, the state works with input from partners to identify projects to place in the SIS Multimodal Cost Feasibility Plan. This includes both "top down" and "bottom up" approaches to project prioritization as the state works with metropolitans planning organizations (MPOs), other government agencies, and stakeholders to achieve consensus.

The SIS Investment Tool (SIT) (*FLDOT 2008*) was developed specifically for prioritizing highway capacity expansion projects and is available online in a user framework such that users can change the weights assigned to the different categories and see how that affects the results. Although this is a tool suggested for multimodal investment prioritization on the SIS, it has only been applied to highway capacity project prioritization. It has three components: A Viewer (which enables the user to view data on the SIS system), the Analyser (which has 24 measures to evaluate and score projects based on the five SIS goals) and a Reporter (where results are made

available in a variety of frameworks and weights used in the evaluation process can be changed instantaneously).

It provides a link between the prioritization process and freight performance measures that have been developed. Twenty-four prioritization measures have been identified and each measure is assigned a weight depending on how important the measure is considered to meeting the five SIS goals of safety and security, system preservation, mobility, economics, and quality of life (Table 2.1).

In addition to the SIT tool, FLDOT also has developed a process for prioritization of rail projects (*FLDOT 2010b*). The rail needs prioritization plan was "developed, tests, and refined through multiple meetings with FLDOT and other stakeholders." (p.3) A list of measures that could "…be used to assess each proposed rail need's performance in relation to the rail plan's five goals was developed and, with input from FLDOT and the Rail Stakeholder Advisory Committee, this list was refined into a series of quantifiable and non-quantifiable measures of the benefits resulting from investment in rail needs." (p.3)

The state rail division uses the Freight Rail Improvement Calculator (FRIC), for calculating the benefits from certain individual freight improvement projects. Macroeconomic impacts of these projects are calculated using the HERS model as well as the REMI model to calculate statewide development benefits from projects. Used in these calculations are specific freight performance measures, although some of these are just "yes"/"no" measures that are difficult to quantify. Their methodology is complex and includes estimates of benefits derived from a diversion of auto and truck traffic from highways. (See *FLDOT 2010b*, Appendix for details).

Table 2.1: SIT Highway Connector Measures (Table 3.1 from the SIT Handbook *FLDOT 2008*, p. 3.3)

Goal Measured	Measure	Maximum Score
Safety and Security	Crash Ratio	10
	Fatal Crash	4
	Bridge Appraisal Rating	3
	Link to Military Base	3
	Possible Subtotal	***20 points***
System Preservation	Volume /Capacity (v/c) Ratio	10
	Truck Volume (AADTT)	6
	Vehicular Volume (AADT)	2
	Bridge Condition Rating	2
	Possible Subtotal	***20 points***
Mobility	Connector Location	1
	Volume /Capacity (v/c) Ratio	4
	Truck Volume (% Trucks)	2
	Vehicular Volume (AADT)	2
	System Gap	2
	Change in v/c -LOS (for Mainline segments only) Interchange Operations (for Interchanges only)	3
	Bottleneck/Grade Separation	2
	Delay	4
	Possible Subtotal	***20 points***
Economics	Demographic Preparedness	5
	Private Sector Robustness	5
	Tourism Intensity	5
	Supporting Facilities	5
	Possible Subtotal	***20 points***
Quality of Life	Land and Social Criteria	4
	Geology Criteria	4
	Habitat Criteria	4
	Water Criteria	8
	Possible Subtotal	***20 points***
	Total Maximum Score	**100 points**

2.2 GEORGIA

In Georgia, the fundamental metric for project evaluation is a Cost-Benefit Analysis (CBA). Once the CBA is completed for individual projects, they are grouped into "freight packages" intended to improve highway freight flow across the state. The final stage of prioritization is feedback from stakeholder groups.

Section 3 of the "Georgia Freight and Statewide Logistics Plan" (GFSLP) (*GaDOT 2011*) discusses the methodology for evaluating individual freight improvement projects. For port and rail improvements, the evaluation relies on previous reports. For airport improvements, CBA relies on "qualitative descriptions from discussions with airport staff". Highway projects either rely on the state DOT travel demand model or what is referred to as '"off model" analytical technique' (*GaDOT 2011*: Discussion of this technique begins on page 3.1). Table 2.2 from the GFSLP illustrates the rationale behind designating a project as a freight priority.

Table 2.2: Georgia Prioritization (*GaDOT 2011*: p. 4.1)

Project Category	Project	B/C Ratio (or other benefit)	Priority Freight Project?	Rationale
Port	Savannah Harbor Expansion Project	$2.8 billion in transportation cost savings	Y	High return on investment, stakeholder input makes this the top freight priority in the state
Port	Develop Jasper Port	$9 billion in tax receipts	Y	High return on investment, needed to maintain Savannah growth momentum
Rail	Develop systemwide rail improvements	3.30	Y	High B/C ratio. Need to accommodate future rail growth
Highway – Long Haul	I-85 Atlanta-SC Line	1.81	Y	High B/C ratio. High truck volumes.
Highway – Long Haul	I-20 Atlanta-AL Line	1.52	Y	High B/C ratio. High truck volumes
Highway – Long Haul	I-85 Atlanta-AL Line	1.32	Y	High B/C ratio. High truck volumes
Highway – Long Haul	I-75 Atlanta-Macon	1.24	Y	High B/C ratio. High truck volumes
Highway – Long Haul	I-20 Atlanta-SC Line	0.91	N	Low B/C ratio. Long-term capacity sufficient
Highway – Long Haul	I-95 (entire state)	0.83	N	Low B/C ratio. Long-term capacity sufficient
Highway – Long Haul	I-75 Macon-FL line	0.64	N	Low B/C ratio. Long-term capacity sufficient
Highway – Long Haul	I-75 Atlanta-TN Line	0.43	N	Low B/C ratio. Long-term capacity sufficient
Highway – Long Haul	I-16 Macon-Savannah	0.28	N	Low B/C ratio. Long-term capacity sufficient
Highway- Smaller Urban and Rural Freight	U.S. 84	0.63	Y	High B/C ratio. Important truck route

2.3 MARYLAND

The Maryland Transportation Plan provides the following six “critical issues facing Maryland” (*Maryland DOT 2009*, p. 6):

1. Transportation and the economy
2. Freight demand and infrastructure capacity
3. Planning for development
4. Transportation and the environment
5. Transportation needs outpacing funding resources
6. Transportation-related fatalities and injuries

In the Maryland Statewide Freight Plan the following definition is provided for a freight project (*MdDOT 2010*, p. 8.1):

> *"A freight project is a planned improvement to the Maryland transportation system that sustains goods movement and supports the state's economic competitiveness. The project may provide improved operations, expansion, or new capacity. It is distinguished from other transportation projects because it provides improved service or capacity to one of the freight modes (highway, rail, water, air) on a transportation facility that significantly supports the local, regional, state, or national economy." (p. 8.1)*

Projects listed in the freight plan were developed from a variety of sources and activities, including freight stakeholder outreach, Maryland's Consolidated Transportation Program, and the Mid-Atlantic Rail Operations Study (a full list can be found in the 2010 Maryland DOT report, p. 8.1).

The evaluation criteria for freight projects are outlined in Table 2.3. The weights used in Table 2.3 were developed iteratively using feedback from the Interagency Advisory Committee (IAC), the Freight Stakeholder Advisory Committee (FSAC), and other freight stakeholders. The Maryland DOT then decides which projects to include in the Consolidated Transportation Program. To do this requires examining and evaluating the funding sources for these projects. Funding for the Maryland transportation infrastructure is centralized from the DOT and not specifically allocated to highways (Interview with Brad Smith February 23, 2013).

Table 2.3: Maryland Evaluation Criteria (*MdDOT 2010*, p. 8.3)

Criteria	Weighting	Description
Quality of Service	30 %	Potential for the project to reduce delay and increase reliability
Safety and Security	25 %	Potential for the project to provide a safer operating environment and reduce opportunities to compromise the supply chain
Environmental Stewardship/Development Plan Goals	10 %	Potential for the project to reinforce the development of freight-related land uses within existing freight activity centers or direct new development to PFAs and sites with adequate infrastructure
Connectivity for Freight Mobility	25 %	Potential for the project to enhance connectivity between freight modes and/or improve access to clusters of freight-intensive industries
Coordination	10 %	Potential for the project to fulfill the plans, programs or goals of multiple agencies

As an example of the scoring system for highway projects, the specific scores are assigned as follows for each one of the criteria shown in Table 2.3 (from *MdDOT 2010*, p.8.4-8.5):

Quality of Service: This rating is an equal weighted combination of Average Annual Daily Truck Traffic (AADT), truck percentage, current Volume/Capacity ratio (V/C), and future V/C ratio. Each project is given a score of high (5.0), medium (3.0) or low (1.0) for each characteristic based on where it stands relative to the other projects.

Safety and Security: This rating is a combination of a safety rating (90 percent) and a security rating (10 percent). The safety rating is based on the average yearly truck crash rate per mile and the security rating is based on whether the project involves the development of a truck inspection/weigh station.

Environmental Stewardship/Development Plan Goals: This rating is based on whether the project is entirely within a Priority Funding Area (PFA) or connecting two PFAs. If a project is entirely within a PFA, it is scored high (5.0); if it is not entirely within a PFA but connects two PFAs, it is scored medium (3.0); and if it is neither in a PFA nor connects PFAs, it is scored low (1.0).

Connectivity for Freight Mobility: This rating is based on whether the project is within or connects to a freight cluster either within Maryland or within 20 miles of Maryland**'**s border. [This is followed by a list of areas determined to be freight-intensive industry employment sites.] If a project is within or connects to one of the freight clusters listed, it is scored high (5.0); if it does not lie within or connect to one of the freight clusters, it is scored low (1.0). Coordination: The Coordination rating is based on the extent to which the project is identified in various agency plans.

A similarly detailed explanation of the scoring system for each criterion is included for rail (*MdDOT 2010*: p. 8.5-8.6). For port projects, the report says simply "Each of the projects were scored using the professional judgment of Maryland Port Administration (MPA) officials" (p. 8.6). The information for each mode is then presented in a table similar to Table 2.4 where each project is assigned a different score for each criterion and projects are ranked by mode.

Table 2.4: Maryland Highway Projects (*MdDOT 2010*, Table 8.2)

Map ID	Name of Project	Jurisdiction	Overall Score	Quality of Service (30 %)	Safety and Security (25 %)	Environmental Stewardship/ Development Plan Goals (10%)	Connectivity for Freight Mobility (25%)	Coordination (10%)
3	Interstate 81 Reconstruct and widen- WV Line to PA Line	Washington County	●	●	◑	●	●	◑
5	Interstate 70 Reconstruct and widen – I -81 to Frederick County Line	Washington County	●	●	◑	◑	●	◑
6	Interstate 70 Reconstruct and widen – Washington County Line to west of Mt. Phillip Road	Frederick County	●	●	◑	○	●	◑
8	Reconstruct and widen U.S. 40-U.S. 15 to I-270	Frederick County	●	◑	◑	●	●	◑
9	Reconstruct and widen MD 85 – English Muffin Way to N. of Grove Road	Frederick County	●	●	◑	●	●	◑
10	Interstate 270 Reconstruct and widen – Montgomery County Line to I-70	Frederick County	●	●	◑	◑	●	◑
11	Interstate 270 Reconstruct and widen – I -370 to Frederick County Line	Montgomery County	●	●	◑	◑	●	●
13	Interstate 270 Reconstruct and widen – I-495 to I370	Montgomery County	●	●	◑	●	●	●
15	Interstate 495 Reconstruct and widen – Montgomery County Line to I-95	Prince George's County	●	●	●	●	●	◑
16	Interstate 95 Reconstruct and widen – South of MD 210 to I-495	Prince George's County	●	●	●	●	●	○
17	Reconstruct and widen U.S. 50-D.C. Line to MD 410	Prince George's County	●	◑	●	●	●	◑
25	Interstate 95 Reconstruct and widen – I -495 to Howard County Line	Prince George's County	●	●	●	●	●	◑
26	Interstate 95 interchange and collector road construct – Contee Road	Prince George's County	●	●	●	●	●	◑
27	Reconstruct and widen MD 175 – Anne Arundel County Line to I-95	Howard County	●	○	●	●	●	◑
29	Interstate 95 Reconstruct and widen – Prince George's County Line to Baltimore County Line	Howard County	●	●	●	●	●	◑

The final prioritization is subjective: it depends on the counties, the stakeholder groups, the available funding, and project size. There is a "balancing" act done to arrive at the final prioritization list. They then come up with a ranking of multimodal projects and try to match available funds with high priority projects. Intermodal facilities may receive a higher priority (Interview with Brad Smith February 23, 2013).

2.4 MASSACHUSETTS

In the Massachusetts Freight Plan, Section 4 details the final freight improvement plans that are proposed (*MaDOT 2010*, section 4). Each major freight corridor was evaluated for each freight mode: rail, air, highway, and maritime; and existing conditions were assessed using a set of freight performance measures. Projects were identified by a working group and stakeholders and developed into a set of five investment scenarios.

The evaluation of investment projects includes three steps:

1. A data collection process,

2. A cost benefit analysis (CBA),

3. An economic impact analysis, which includes direct effects, indirect effects, and induced effects.

Evaluation criteria were utilized to link to freight goals, objectives, and performance measures in the prioritization process for selecting capital infrastructure projects. Projects were organized and packaged together into scenarios by key corridors and intermodal connections to strategically improve and enhance the existing freight system. (*MaDOT 2010*, section 4.1). Each scenario is unique approach to holistically tackling the future of freight in Massachusetts (*MaDOT 2010*, p. 4-13).

They consider two scenarios of rail improvements, two scenarios of multimodal improvements (which are basically connectors between modes), and a truck highway improvement scenario. They consider total costs for each and then calculate a benefit-cost ratio using direct, indirect, and induced benefits including environmental, congestion, time savings and mode-switching impacts. They estimate that 75 to 92 percent of the benefits in four out of five of their scenarios accrue to shippers and carriers, and thus conclude that this may be a situation where public-private partnerships might be considered.

Massachusetts DOT provides the in-depth methodology used to evaluate different aspects of the investment scenarios (beginning on page 4.2). However, the specific prioritization process is not addressed in any document found other than reference to this information being used in the context of policy recommendations.

2.5 MISSOURI

The state of Missouri Department of Transportation (MoDOT) has a division of Multimodal Operations that is responsible for supporting alternative transportation programs within the state. This division includes strategic planning for aviation, rail, transit, waterways, and freight development. A stated goal for freight development is to "Encourage freight initiatives that promote economic development and efficient movement of goods" (*MoDOT 2012*, p. 5).

For the state of Missouri, there is no multimodal investment ranking system. Rather, there is a framework for Transportation Planning and Decision Making (*MoDOT 2004*) which was developed for prioritization of road and bridge projects and which has been adapted for use on Waterway investments. Staff are hopeful this framework will be used for multimodal investment decision-making, but it has not yet been refined for that purpose (Interview with Patricia Ball, February 14, 2013).

The framework used for project prioritization involves scoring projects according to the perceived ability of the project to attain the various stated objectives and goals established by the MoDOT. Once needs are identified, physical and functional needs are prioritized separately.

Weights and point values for each transportation goal are determined by MoDOT, the regional planning organizations (RPOs) and the metropolitan planning organizations (MPOs). After points have been assigned, a weighted average is calculated for each project and they are allocated to high, low, and medium priority groups. Table 2.5 and Table 2.6 are examples of the scores and weighting system that Missouri applies. Further examples are provided on p. 40-44 in MoDOT (*2004*).

Table 2.5: Missouri Functional Needs (*MoDOT 2004*, p. 40)

Functional Needs

Prioritization Process

Functional Needs
11/04/2003

This process does not apply in TMA areas

Access to Opportunity
Weight: 5% minimum - 30% maximum

Vehicle Ownership	50 pts
District Factors/Flexible Points	50 pts
Total	**100 pts**

Congestion Relief
Weight: 5% minimum - 30% maximum

Level of Service	25 pts
Daily Usage	25 pts
Functional Classification	25 pts
District Factors/Flexible Points	25 pts
Total	**100 pts**

Economic Competitiveness
Weight: 5% minimum - 30% maximum

Level of Economic Distress	30 pts
Supports Regional Economic Development Plans	20 pts
District Factors/Flexible Points	50 pts
Total	**100 pts**

Efficient Movement of Freight
Weight: 5% minimum - 30% maximum

Truck Volume	50 pts
Freight Bottlenecks	20 pts
Intermodal Freight Connectivity	10 pts
District Factors/Flexible Points	20 pts
Total	**100 pts**

Quality of Communities
Weight: 5% minimum - 30% maximum

Connectivity	40 pts
Complies with Regional or Local Transportation Plans	30 pts
District Factors/Flexible Points	30 pts
Total	**100 pts**

Environmental Protection
Weight: 0% minimum - 30% maximum

District Factors/Flexible Points	100 pts

Safety
Weight: 20% minimum - 50% maximum

Safety Index	85 pts
Safety Concern	5 pts
District Factors/Flexible Points	10 pts
Total	**100 pts**

Taking Care of the System
Weight: 5% minimum - 30% maximum

Substandard Roadway Features **OR** Substandard Bridge Features	75 pts
District Factors/Flexible Points	25 pts
Total	**100 pts**

- **The glossary explains how each factor is scored.**
- **MoDOT Districts will allocate 50% of the weight among investment goals.**
- **"District Factors/Flexible Points" may be used to capture unique items that are important to an individual region or can be allocated among existing factors.**
- **The weight of investment goals must meet minimum and maximum percentages noted above. The total weight of all investment goals must equal 100%.**
- **MPOs designated as Transportation Management Areas may develop their own functional needs prioritization process, subject to certification by MoDOT.**

Table 2.6: Missouri Taking Care of System Projects (*MoDOT 2004*, p. 41)

Prioritization Process

Taking Care of the System
11/04/2003

Taking Care of the System Projects

This process applies to all areas of the state

Access to Opportunity	
Weight: 0% minimum - 20% maximum	
Eliminate Bike/Ped Barriers (ADA)	25 pts
Vehicle Ownership	25 pts
District Factors/Flexible Points	50 pts
Total	**100 pts**

Congestion Relief	
Weight: 0% minimum - 20% maximum	
Level of Service	75 pts
District Factors/Flexible Points	25 pts
Total	**100 pts**

Economic Competitiveness	
Weight: 0% minimum - 20% maximum	
Strategic Economic Corridor	30 pts
Level of Economic Distress	20 pts
District Factors/Flexible Points	50 pts
Total	**100 pts**

Efficient Movement of Freight	
Weight: 0% minimum - 20% maximum	
Truck Volume	90 pts
District Factors/Flexible Points	10 pts
Total	**100 pts**

Quality of Communities	
Weight: 0% minimum - 20% maximum	
District Factors/Flexible Points	100 pts
Total	**100 pts**

Environmental Protection	
Weight: 0% minimum - 20% maximum	
Environmental Index	50 pts
District Factors/Flexible Points	50 pts
Total	**100 pts**

Safety	
Weight: 5% minimum - 25% maximum	
Safety Index	70 pts
Safety Concern	10 pts
Safety Enhancements	10 pts
District Factors/Flexible Points	10 pts
Total	**100 pts**

Taking Care of the System	
Weight: 75% minimum - 95% maximum	
Roadway	
Pavement Smoothness	30 pts
Pavement Condition	20 pts
Functional Classification	10 pts
Daily Usage (all vehicles)	10 pts
Truck Usage	10 pts
Substandard Roadway Features	10 pts
District Factors/Flexible Points	10 pts
Total	**100 pts**
- OR -	
Bridge	
Bridge Cndition	40 pts
Exceptional Bridge	10 pts
Functional Classification	10 pts
Daily Usage (all vehicles)	10 pts
Truck Usage	10 pts
Substandard Bridge Features	10 pts
District Factors/Flexible Points	10 pts
Total	**100 pts**

- **The glossary explains how each factor is scored.**
- **MoDOT Districts will allocate 20% of the weight among all investment goals.**
- **"District Factors/Flexible Points" may be used to capture unique items that are important to an individual region or can be allocated among existing factors.**
- **The weight of investment goals must meet minimum and maximum percentages noted above. The total weight of all investment goals must equal 100%.**

Although the planning framework has a complex scoring system, it also makes use of involvement by stakeholders and includes 3 representatives from all 19 state transportation regions to make the project prioritization decisions (from a telephone interview with Cheryl Ball, the Administrator of Freight Development on February 14, 2013). Weights for each factor are subject to change depending on the collective preferences of the stakeholders. Projects are divided into two groups: smaller regional projects and major projects, which affect the state system. Representatives from each of the nineteen state transportation regions convene for a day to determine weights to be applied for the larger projects. Thus, this system involves a scoring

process but also heuristics as the subjective opinions of stakeholders are considered and weights change over time with changes in members and opinions of the various stakeholders involved in the process. Stakeholder groups prefer this combination approach as opposed to strictly adhering to the rigid, mechanistic ranking systems of a "top-down" type of decision-making. Thus, there is a planning tool available to support the decision-making process, but there is the flexibility to address regional concerns

Although not used at the project level, the state also does an economic impact analysis of projects proposed for the state transportation improvement plan (which are not just freight related projects). For this purpose they use the REMI model to determine the economic impact of the entire STIP.

All funds are administered by the state and the rail, water, and highway funds are allocated by the transportation planning director using an approved funding formula. The waterway division developed a tool for prioritizing projects, but the tool was not used because the waterway division only received enough funding to support small projects. In general, each mode is looked at a bit differently and each meets with the planning division and with stakeholders to determine modal priorities (Interview with Michele Teel, November 26, 2012). For example, there is a planning framework used to rank bridge and highway projects that is intended to be multimodal. The 19 districts do their own project prioritization for smaller regional projects, but for major projects representatives from each of the 19 state districts help prioritize (Interview with Cheryl Ball, February 14, 2013).

2.6 OHIO

The state of Ohio has a Transportation Review Advisory Council (TRAC) established by the Ohio General Assembly in 1997 to develop and oversee the project selection process for major new capacity projects (defined as those over $12 million). The TRAC was created not just to deal with road and bridge projects, but to make decisions on transportation projects of regional and statewide importance (*OhDOT 2011*). The TRAC define criteria and scoring for major new capacity projects and, in doing so, give equal consideration to road, transit, intermodal and freight projects. Accordingly, the TRAC has developed a "scoring criteria that can be applied equally to any mode, or surrogate criteria so that modal benefits can be compared in an equal fashion across modes." (*OhDOT 2011*, p.8)

There are three broad Criteria (or Factors) for scoring Ohio DOT project proposals: Transportation, Community and Economic Growth and Development, and Project Sponsor Investment. Under the Transportation Factor (Criteria), there are five sub-factors: Traffic, Benefit and Cost, Air Quality, Functional Class and Intermodal Connectivity. Community and Economic Growth and Development have four sub-factors: Adopting Appropriate Land Use Measure, Positioning Land for Redevelopment, Economics Impact, and Considering Factors of Economic Distress.

2.7 OREGON

Oregon has a very detailed freight plan that is clearly aimed at being a statewide plan for the multimodal system of freight transportation in the state. The plan "Supports identifying, prioritizing and facilitating investments in Oregon's highway, rail, marine, air and pipeline transport infrastructure to further a safe, seamless multimodal and interconnected freight system." (*ODOT 2011*, p. 23)

The Oregon Freight Plan discusses the need to account for various factors in the prioritization process and suggests identifying corridors that are part of the strategic freight system. Indeed, many of the states that are the furthest along in the consideration and comparison of multimodal investment decisions for freight do so on a corridor basis. Currently Oregon's DOT does not have a report detailing the specifics on exactly how projects are compared, prioritized or ranked, especially when there are several objectives for the corridors that could be accomplished by investments in more than one mode.

The ConnectOregon program deals with non-highway investment projects in Oregon and has a set of criteria for which each project is evaluated. The stakeholders then meet and rank projects for each mode and then a committee meeting is held to rank the projects. The procedure is described in detail in McMullen (*2010*). At this point there is no standard way to calculate impacts, such as the number of jobs created by a project. Thus, the impacts for each project and mode are estimated, and there is little consistency in these measures across modes or even projects.

The ConnectOregon program asks evaluators of projects to consider the following criteria when evaluating a project:

1. Whether a proposed transportation project reduces transportation costs for Oregon businesses or improves access to jobs and sources of labor;

2. Whether a proposed transportation project results in an economic benefit to this state;

3. Whether a proposed transportation project is a critical link connecting elements of Oregon's transportation system that will measurably improve utilization and efficiency of the system;

4. .How much of the cost of a proposed transportation project can be borne by the applicant for the grant or loan from any source other than the Multimodal Transportation Fund; and

5. Whether a proposed transportation project is ready for construction

For the most part the answers are "Yes/No" and the various criteria are not weighted.

Recently the state of Oregon DOT has been working on a least-cost-planning (LCP) framework as defined by the 2009 Oregon legislature:

> *"Least-cost planning means a process of comparing direct and indirect costs of demand and supply options to meet transportation goals, policies or both, where the intent of the process is to identify the most cost-effective mix of options"* (*CH2MHill 2011*).

Accordingly, the LCP division has contracted to develop a tool to facilitate planning to meet this least cost ideal. The tool, named MOSAIC (*ODOT 2013*), is an Excel spreadsheet framework that includes both monetary and non-monetary measures to evaluate and compare potential programs including a range of projects. MOSAIC was developed including input from the Statewide Transportation Improvement Program (STIP) Stakeholder Committee (SSC), technical teams from ODOT, the Oregon Transportation Commission (OTC) and other agencies.

MOSAIC includes a section in which Benefit-Cost analysis (BCA) is used to monetize values for benefits and costs of a particular program of investments using monetary values and costs provided by the program. This provides results such as a benefit-cost ratio or the net present value (NPV) of a set of investment projects. For items for which there is a difficulty assigning a monetary value, a point system is developed with the weights being decided upon by the stakeholder groups. The result is a combination of a BCA and a ranking/scoring system for prioritization.

In the past, the Oregon DOT contracted with the University of California at Davis to develop a tool to rank multimodal mobility improvement projects from a pre-designated set of alternatives (this discussion follows that in *McMullen 2010*). The methodology first required the user to evaluate projects using set criteria and then the tool evaluates final scores using a modified TOPSIS (Technique for Order Preference by Similarity to an Ideal Solution) ranking algorithm (*Franklin and Niemeier 1998*). As explained in McMullen (*2010*, p.31-32), seven evaluation criteria were utilized in the model, each having specific data and methodological requirements. The tool computes a numerical score for each area and then a final weighted score for the project as a whole. Evaluation criteria included:

- The ratio between Net Present Value and Cost (NPV/C ratio)
- Land Use
    - 1a. Compatibility with local land use plans
    - 1b. Growth management
- Environment and Resource

- Economic Development
    - 3a. Whether or not the surrounding region was considered distressed,
    - 3b. Whether or not the improvement project supported a regional transportation strategy
    - 3c. direct use of the distress measure computed by the Oregon Development Department.
- Multimodalism
    - 4a. Multimodal and intermodal connectivity offered by the project
    - 4b. The expansion of mode choice
- Community Support
- Accessibility
    - 6a. Minimum level of service
    - 6b. Basic standards for minimum tolerable conditions. (Ibid.)

After the weights for each performance measure and scores for each candidate project are determined, the TOPSIS ranking algorithm ranks all projects to produce a prioritized list. The TOPSIS-6 ranking procedure includes six steps:

1. Project Scoring
2. Normalizing Scores
3. Weighting Scores
4. Determining Ideal Projects
5. Ranking Projects
6. Selecting Funded Projects.

This tool provides a ranking that is objective once all inputs have been made. However, this methodology was never used by ODOT as it did not have any flexibility.

The state of Oregon is interested in developing a method to do a “side-by-side” comparison of two projects from different modes to determine which will have the biggest impact. In ConnectOregon there are review questions for each project and measures are identified as they move from mode to mode. The scales used change between modes, which makes intermodal comparison difficult (Interview with Michael Bufalino, February 20, 2013).

2.8 WASHINGTON

While a clear prioritization process for highway and rail improvements exists, a comparative multimodal freight prioritization does not exist.

The Washington state legislature created the Freight Mobility Strategic Investment Board (FMSIB) in 1998 to respond to specific freight transportation needs on Washington's strategic freight highway, rail, and waterway corridors. The Board is made up of private and public sector members that represent potential funding partners (*WSDOT 2008*, p.4).

2.8.1 Highway

The FMSIB calls for projects roughly every other year, and historically it takes six years from approval to groundbreaking on a project. The methodology for project selection follows (*WSDOT 2008*, p.7):

1. A technical scoring team is assembled with members from state interests, local interests, and the private sector

2. Project sponsors submit responses to FMSIB application.

3. An engineering review is conducted and data submitted is verified.

4. Individual scores are combined and reviewed by both teams. Projects that score poorly are eliminated from further consideration.

5. Evaluation meetings include verification reports from carriers and the development of remaining questions to be answered to determine freight mobility improvements and state benefits.

6. Projects that are advanced to the next review are contacted and asked to respond to questions at a face-to-face meeting.

7. The selection committee recommends projects to advance based upon a project's numerical score, fact verification, and determination of benefits.

8. Selection committee determines recommended level of state participation based on freight share of project benefits.

9. Full FMSIB reviews each recommended project, level of participation, and makes final decision to adopt and funding level.

10. Prioritized recommendations are submitted to the Legislature for funding consideration.

Each proposed project is reviewed by a selection and technical scoring team, and is evaluated and ranked based on the following weighted criteria:

1. Benefit of freight mobility for the project area
2. Freight mobility benefits for the region, state and nation
3. General mobility benefits
4. Safety improvements
5. Freight and economic value to the region and the state
6. Environment benefits including diesel emission
7. Partnership funding
8. Consistency with regional and state plans
9. Cost benefit analysis
10. Special issues

The selection team recommends, and the Board adopts, the prioritized list of projects, and establishes the appropriate state freight share of the overall project cost. FMSIB funding may not exceed this identified state freight share. The remainder of the project must be funded by the local sponsor and other public and private financial partners in compliance with FMSIB's charge to leverage the greatest amount of non-program funds possible.

2.8.2 Rail

The freight rail benefit/impact evaluation methodology and tools developed by WSDOT, in collaboration with FMSIB and other key stakeholders, aligns with these legislative priorities. They use both quantitative and qualitative analysis techniques to document the project's logistics, resources, goals, and support of broad industry sectors.

1. A benefit/cost analysis is applied on all projects. The major categories for benefit/cost analysis are transportation and economic benefits, economic impacts, and external impacts. A benefit/cost ratio greater than 1.0 shows that the benefits of a project outweigh the costs; a ratio of less than 1.0 indicates that the costs outweigh the benefits.
2. A weighting system is used to rank how well a project meets the priorities.
3. In addition, a project management analysis tool is included to help determine if the project can be delivered within known constraints.
4. The user benefit level analysis determines which users benefit from the project and at what level.

WSDOT also prioritizes highway projects but uses a more intricate process, classifying projects into high- or medium-benefit categories. They identify high-priority performance gaps identified and documented in WSDOTs surveys with shippers, carriers, and other stakeholders. They identify bottlenecks, chokepoints and safety issues on high-volume truck freight corridors that might be alleviated by proposed projects (*WSDOT 2008*, p. 10-11). The state is still developing a detailed benefit-cost methodology to aid in this process.

The FMSIB uses the same method to prioritize both highway and rail projects, thus making their comparison "mode-neutral".

A tool developed for WSDOT was the Multimodal Investment Choice Analysis (MICA) program for freight investment analysis. The purpose of the MICA was to "summarize the multimodal budgetary tradeoffs that will result from varying funding allocation and priority scenarios." (*Young et al 2002*) In particular, MICA is a multimodal decision making tool able to handle a wide variety of projects (e.g., capacity enhancement, preservation, etc.). To use MICA, the analyst enters information at three levels: project level, scenario level, and scenario comparison. See McMullen (*2010*) for a more detailed discussion of MICA methodology.

"While MICA provides a prioritized list of multimodal investment projects, it may be criticized on the significant reliance on expert knowledge and inputs, while the value of objective data and information is not fully explored. Since the MICA model contains a pre-determined set of performance measures, the analyst can only choose to include a subset of these measures in a particular analysis. However, MICA cannot include any performances measures outside its pre-programmed set. This could be a shortcoming for generalized multimodal tradeoff analyses, because decision-makers may prefer to include measures not included in MICA, e.g. regional equity."(*McMullen 2010*, p. 31).

According to an interview with Rachel Knutson (March 27, 2013), WSDOT is planning to use the six-step process below in the Freight Mobility Plan currently being developed to introduce the benefit/cost and economic impact methodology (*WSDOT 2008*, p 8):

1. Identify a problem or deficiency.

2. Explore possible solutions.

3. Develop a scope for the project, which takes into consideration possible environmental impacts, roadway design issues, and stakeholder concerns.

4. Based on project scope, develop a cost estimate or estimated range.

5. Determine the benefit the project will provide.

6. Compare the costs and benefits of the project with other projects of its type to determine its order of rank and priority.

Washington does not currently have any way to directly compare projects across modes. Although benefit-cost analysis is used, the ultimate decisions are made in consultation with both public and private stakeholders and often a scorecard type of system is used. Because, it is often

difficult to explain benefit-cost analysis results to stakeholders and the public, there is frequently reliance on a scorecard approach to ranking projects (Interview with Rachel Knutson, March 27, 2013).

2.9 THE PUGET SOUND REGION (WASHINGTON STATE)

As an interview with WSDOT staff indicated the Puget Sound Regional Council (PSRC) probably had the most developed methodology for project prioritization (Rachel Knutson, March 27, 2013, their process is reviewed in addition to various state DOT methods described above. Vision 2040 is the region's long-term strategy for sustainable development, and the Transportation 2040 (T-2040) plan is one branch of this vision (*PSRC 2012a*). T-2040 addresses both freight and multimodal transportation as components to the overall mission. However, they are but two evaluation components in measuring proposed projects. The Puget Sound ranks projects with a scorecard method similar to Maryland's DOT, with the nine ranking components given a relative score of 1 to 5 (*PSRC 2012b*). Table 2.7 below is an example of the scorecard. Each project is given a score based on the ranking components, but a cost-benefit ratio is also used as an additional way to compare projects. For a description of the project types, see page 6 in the Puget Sound Regional Draft Report (*PSRC 2012a*).

Table 2.7: Puget Sound Highway Project Scorecard (*PSRC 2012a*, p. 10)

PROJECT	AIR QUALITY	FREIGHT	JOBS	MULTI-MODAL	PUGET SOUND LAND & WATER	SAFETY & SYSTEM SECURITY	SOCIAL EQUITY & ACCESS TO OPPORTUNITY	SUPPORT FOR CENTERS	TRAVEL	SCORE	COST	BENEFIT	NET BENEFIT	BC RATIO
PROJECT A	◓	◓	◓	◓	◓	○	◓	◓	○	7	$ 36	$ 357	$ 322	10.0
PROJECT B	◓	◎	◎	◎	○	○	◓	◡	○	7	$ 503	$ 2,474	$ 1,971	4.9
PROJECT C	○	○	◓	◓	○	○	○	◓	○	3	$ 34	$ 127	$ 93	3.7
PROJECT D	◓	◓	○	○	◓	◡	○	○	○	2	$ 259	$ 310	$ 52	1.2

Scoring symbols: ◎ Largest benefit; ◓ Larger benefit; ○ Average benefit; ◡ Smaller benefit; ● Smallest benefit

All dollar values are in millions and represent totals in present terms.

Even though Multimodal-Freight projects are not a specific improvement category, they are important considerations for every project consideration. Table 2.8 and Table 2.9 below illustrate the scoring criteria for the Multimodal and Freight scoring components in the Puget Sound process. Measures without examples provided in this summary are: Air quality, social equity and access to opportunity, jobs, multimodal, Puget Sound land and water, support for centers, safety and system security and travel.

Table 2.8: T-2040 Multimodal criteria (*PSRC 2012b*, p. 4)

	Purpose: Improve alternatives to driving alone. How well does the project improve mobility through alternatives to driving alone?	
	2	The project improves opportunities for transit, special needs transportation services, or vanpool use (may include intermediary facilities such as Park and Rides).
	2	The project adds incentives[8] or removes barriers[9] for individuals to use fixed-route transit, special needs transportation services, or vanpools.
	1	The project improves opportunities for bicycle and pedestrian travel.
	1	The project implements a portion of the regional bicycle network[10], and is included in a local plan.
	2	The project adds incentives or removes barriers for individuals to use non-motorized travel modes.
	1	The project includes additional tools or strategies to reduce the proportion of drive-alone trips[11]
	Purpose: Improve connections between transit and non-motorized modes. How well does the project improve connections between modes of travel, especially for bicyclists and pedestrians accessing transit?	
	1	The project improves bicycle and pedestrian access within ¼ mile of a (MTS[12]) transit stop.
Total	10 (max)	

Table 2.9: T-2040 Freight Criteria (*PSRC 2012b*, p. 2)

	Purpose: System performance benefits for freight. How well does the project provide benefits to freight-related system users by improving travel time, reliability, and efficiency for freight haulers (all freight modes), and how well does the project reduce conflicts?		
Points	3		The project improves a facility identified as a freight bottleneck through the Washington State Department of Transportation's Truck Performance Measures program[3] or other adopted agency plan.
	1		The project reduces conflict between freight modes (truck and rail)—e.g. grade separation or bridge openings.
	1		The project reduces conflict with freight and one or more passenger modes—e.g. through a separation of modes such as a pedestrian overpass or separated parallel bicycle facility.
	Purpose: Access to freight-related areas. How well does the project support planned development in Manufacturing and Industrial Centers (MICs) and other freight-related areas?		
	Choose one	2	The project improves access within, or to, more than one MIC (or between a MIC and a Regional Growth Center)
		1	The project improves access within or to one MIC
	1		The project improves access to an area identified in the Regional Freight Strategy as a freight generator.[4]
	Purpose: Improves key freight facility. How well does the project serve designated *Freight and Goods Transportation System*[5] routes?		
	2		The project is on a designated T-1 or T-2 route
Total	10 (max)		

Perhaps because their benefit-cost analysis is one component of their scorecard, the benefit-cost tool used by PSRC is straightforward, relying only on travel demand model output. Because the results rely so heavily on the travel model, the level of detail that is possible in their BCA analysis is limited by the model output aggregation. The methodology used in the PSRC BCA tool is the same as used in the AASHTO "Red Book" and is implemented in software developed by ECONorthwest to convert their regional travel model output (EMME/3) to monetary values in format readable by standard spreadsheet software. (*PSRC 2009, PSRC 2010*)

2.10 SUMMARY

A survey of state Department of Transportation web sites yielded surprisingly few formal methodologies used for ranking or prioritization of investment projects for freight. None had a formal tool or methodology they used for comparing and ranking projects across modes. Tools used fell into two broad categories: some sort of Benefit Cost Analysis (BCA), a scorecard approach with points assigned to various criteria and weights, or some combination of the two.

In the case of the USDOT, to provide a "mode neutral" decision for TIGER funds, only projects with a BC Ratio greater than 1 were considered. However, it was difficult to compare BCA across states even for one mode (say highway projects) due to the differing methodologies employed by the states. USDOT evaluators study the method used by each state and then make revisions they deem appropriate to make such comparisons most appropriate (Personal conversations with Jack Wells, Chief Economist, USDOT 22 March 2013). However, final decisions use the BCA information as only one part of the entire decision-making process that involves considerable input from both public and private stakeholders.

The USDOT example underlines the need to develop a transparent methodology that will enable policymakers to make meaningful comparisons across a single mode and to make "mode-neutral" investment prioritization decisions.

In cases where there is purely objective methodology developed to rank projects (such as Oregon's TOPSIS), there is strong resistance to relying on the tool. Indeed, this underscores the need to provide information to decision-makers while allowing them flexibility. Informal discussions suggest while BCA methods can be refined in a way that helps inform transportation professionals, BCA is often not understood or viewed by the public as being particularly useful. Indeed, sometimes such sophisticated techniques may be received with skepticism by the public. For this reason scorecard approaches may also be used as they are easier for the general public---and many stakeholders---to understand (a combined approach is used in both the PSRC and MOSAIC processes.)

3.0 ACADEMIC AND SUPPORTING LITERATURE

The goal of this effort is to identify opportunities to prioritize freight-related projects across modes. Most of the existing literature, however, is mode-specific and this section is organized accordingly. In addition, the published literature on this topic is rather sparse, aside from passenger highway travel. Because there are few synthesis papers available, this section will also draw on case studies as necessary to illustrate the range of tools in use.

3.1 TRUCK TRAVEL & HIGHWAY PROJECTS

Sage et al. (*2012*) completed a comprehensive review of the literature regarding highway freight benefits and economic impacts. Their work found most currently implemented BCA tools quantify the benefits in terms of avoided crashes and reduced travel time (as measured by a number of different metrics) and the costs in terms of construction, operating, and user costs. They found most tools do not take into consideration reliability, freight, or economic impacts. Incorporating direct freight impacts in BCA requires sensitivity to reliability, mobility, travel time, and safety. Incorporating indirect freight impacts is more challenging because of the complex nature of economic impacts of the freight system in terms of scale, layered secondary effects, and many different beneficiaries.

Outwater et al. (*2012*) examined the Puget Sound Regional Council's (PSRC) project prioritization method (*PSRC 2009*) using the analytical hierarchy process and conjoint analysis to weight various measures within the process. The intention was to ensure the project prioritization process was sensitive to the goals outlined in their long-range regional plan – Vision 2040 – and included stakeholder input. One of the five stated goals addresses freight and includes: "Prosperous economy. Whether the project encourages growth in employment and improves the movement of goods." (p. 112). The measures related to freight include measures of overall mobility, applicable to all modes passenger and freight alike (such as travel time and reliability benefits). Specific measures that target freight movement include "Benefit to trucks" and "Fostering economic growth". These measures are reported through the region's combined travel demand and land use modeling tools. While the projects tested within the document included a wide range of modes overall, the benefits and costs - especially as related to freight - primarily dealt with highway impacts and truck movements. The results of the stakeholder survey work indicated Prosperous Economy and Mobility were their two most important goals, and "Benefits to Trucks" was the most important measure. While this effort does include a BCA sensitive to some impacts of freight, it focuses only on trucks and relies on the results of travel demand models for insight, noted in Wygonik et al. (*undated*) to be not particularly sensitive to truck travel.

Gong et al. (*2012*) also used the analytic hierarchy process as well as willing-to-pay to estimate the value of delay to shippers to measure the impacts of highway investment to the freight community. They discuss how difficult it can be to parse out the particular costs to the freight industry of transportation. An example is given: if congestion delays a shipment, which then arrives after hours when no one is available to unload the cargo, and that in turn delays

production – how much of the cost of the delay should be attributed to congestion and how much to an inflexible operations schedule? Likewise, should changes to operations to account for unreliability be carried as costs to transportation projects, even if they provide other benefits to the operator?

Winterich et al. (*2009*) attempted to identify freight performance measures for urban goods movement that would allow the impact of projects on these movements to be incorporated in project prioritization. Despite efforts to reach approximately 50 private firms, they were able to solicit responses from only a small number. They felt most passenger-based mobility performance measures could be adapted for freight mobility performance. Urban congestion significantly impacts carriers' decisions, though it can often be accounted for. This team suggests including the economic value of delay to specific commodities as a useful way to incorporate freight mobility in project prioritization. That conclusion supports efforts by Andreoli et al. (*2012*) to measure the impact of network change on the potato commodity in Washington state. This work also highlights the importance of identifying useful performance measures for freight travel. Because of the highly complex nature of freight movements and the limited existing data, additional work is needed to identify freight performance measures and gather supporting data. For example Ko's (*2007*) dissertation attempted to develop performance measures necessary to evaluate truck level of service. He identified truck travel time and variance, safety, and ease of mobility as critical for evaluating the usefulness of a roadway for truck access. This is a growing area of attention and a rich area in the literature and many states have been developing performance based measures specifically designed for freight transportation (*McMullen and Monsere 2010*). NCFRP 10 (*Gordon Proctor et al. 2011*) also looked at performance measures for freight transportation, identifying data issues and relevant performance measures across freight modes.

Kim et al. (*2010*) rank freight projects in the Anchorage region based on subjective and objective criteria focused on travel time, congestion, and safety. Survey results from a variety of stakeholders indicated congestion and ease of mobility were primary concerns. Ultimately they ranked projects by crash data, traffic volume, and survey evaluation and considered different weightings of each of these factors.

3.2 AIR FREIGHT

One of the few projects to consider non-highway freight impacts is the WSDOT airport economic impacts tool. This tool is not a project prioritization tool, so it focuses on job creation and business attraction and does not include costs. They consider impacts in terms of the airport, industrial community, and local community users to determine the economic benefit of an airport to the surrounding community. Likewise, Colorado DOT (CDOT) has developed an Economic Impact Study for its airports with the same general goal and structure (*Wilbur Smith et al. 2008*). For this project, total economic impacts were estimated from direct, indirect, and induced economic impacts. Again, this study quantified economic benefits of airports but was not used for project prioritization and thus did not include costs. Colorado does have discretionary revenue to allocate directly to air travel from aviation fuel taxes collected and has an aviation grant program to allocate those funds (*CDOT 2011*). Much like traditional Transportation Improvement Program structures, the aviation grant program requires individual airports to put together a Capital Improvement Program including all of their required or desired projects. These

projects are eligible for review under standard annual review of the Colorado Aeronautical Board, under emergency review, or under special review for larger projects.

The FAA Airport Benefit-Cost Analysis tool allows the FAA to make considered evaluations of proposed airport projects under the Airport Improvement Program (AIP). Evaluation with this tool is required for discretionary projects (it is not required for projects necessary to meet various standards) needing at least $5 million in AIP funding. It considers reduced delay for aircraft, passengers and cargo; improved schedule predictability; more efficient traffic flows; use of larger, faster or more efficient aircraft; safety, security, and design standard benefits; environmental benefits; and operating and maintenance benefits.(*FAA 1999*)

3.3 RAIL FREIGHT

As most rail infrastructure is privately managed, evaluations of publicly-supported rail projects can be more complex. NCHRP 586 (*Bryan et al. 2007*) looked at using freight rail to address roadway congestion and, in doing so, developed a framework for comparing the costs and benefits of both. One useful point made within this document is the differing nature of the costs between rail users and trucks – railroads are responsible largely for their own infrastructure costs and the costs of congestion while trucks share those costs with all roadway users. This report proposes a three-tiered approach to considering freight rail projects: initial screening for viability, consideration of rail options, and comparing other alternatives using BCA. They suggest the following broad categories of measurement: congestion levels and reduction potential, shipping cost and service features, logistics costs, truck to rail diversion, and traffic and economic impacts. They classify benefits and costs as being private, governmental, or public but non-governmental to allow evaluation from different stakeholder perspectives.

NCFRP 12 (*Cambridge Systematics et al. 2011*) includes a case study from Washington State DOT State Rail and Marine Office and provides a nice summary of their process (Figure 3.1).

Table 3.1 summarizes the metrics and measures that are used.

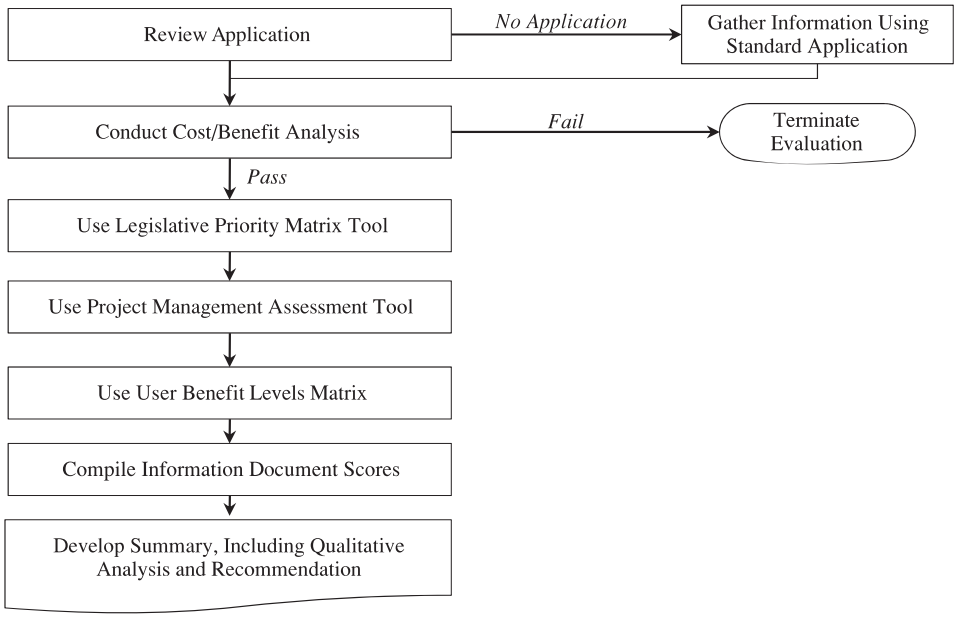

Figure 3.1: Washington State DOT freight rail decision-making process (*Cambridge Systematics et al. 2011*, p. 29)

Table 3.1: Benefit categories included in Washington State DOT's benefit/cost calculator (*Cambridge Systematics et al. 2011*, p. 30)

Benefit/Cost	Measurement of Benefit/Cost
Reduced Maintenance Costs	Based on expected number of rail carloads versus semis and the weight of the shipments
Reduction in Shipper Costs (for Shipments Originating in State) – Freight Only	Comparison of the cost of shipping the goods via rail compared to truck
Reduction in Automobile Delays at Grade Crossings	Value of motorist time (usually a function of average wages) multiplied by expected reduction in delay
New or Retained Jobs	Average wages for the region from the Bureau of Labor Statistics multiplied by an economic multiplier to gauge total impacts
Tax Increases from Industrial Development	Estimated assessed property value after project multiplied by property tax rate
Safety Improvements	Estimated money saved by not having to make highway safety improvements
Environmental Benefits	Total distance traveled by trucks diverted to rail multiplied by a standard environmental cost per mile
Track Maintenance	Estimated cost of track maintenance discounted to net present value
Equipment Maintenance	Estimated cost of equipment maintenance discounted to net present value

Source: Washington State DOT, *Freight Mobility Joint Report*, Appendix A, Exhibit 8.

3.4 SEAPORTS

Like rail infrastructure, evaluating investments in seaports from a DOT perspective can be complex because of the many different entities with financial stakes in the operations and infrastructure. A common practice for DOTs is to conduct economic impact analyses of ports – determining the value of ports to their communities. For example, the Ports of New York-New Jersey, Virginia, and Baltimore completed economic impact assessments in 2008 (*A. Strauss-Wieder et al. 2009, Pearson et al. 2008, Martin Associates 2008*), the Port of Los Angeles completed one in 2007 (*Martin Associates 2007*), and one was completed for Connecticut's deepwater ports in 2001 (*Carstensen et al 2001*).

The Port of New York-New Jersey assessment measures economic impacts with employment effects (direct, indirect, and induced), total business income/revenue effects, total earnings/personal income effects, and total local, state, and federal tax effects. The effects are evaluated using the Rutgers RECON model. The Martin (*2008*) assessment for the Port of Baltimore also considered total employment in terms of direct, indirect, and induced employment (as well as related employment), but the Maryland Port Administration (MPA) is not including the indirect and induced employment numbers when it reports the findings, as earlier reports

only considered direct employment and the MPA and external reviewers were skeptical of the relationship between the Port and the indirect and induced job numbers. As with the Port of New York-New Jersey assessment, the other impacts considered are personal income impact, revenue impact, and tax impacts. While the Port of Baltimore assessment focuses on shipping-related impacts, the Port of Los Angeles assessment, also by Martin (*2007*) includes impacts from cruise activity and marinas, real estate, and fish processing. The same general measurements are used, however: jobs (direct, indirect, induced, and related), personal income, business revenue, and taxes. The Port of Virginia assessment (*Pearson et al. 2008*) focused on impacts from freight shipping and included revenue, employee compensation, and number of employees, with all three evaluated in terms of direct, indirect, and induced impacts. The total impacts are then discussed in terms of tax impacts. The Connecticut Deepwater Ports analysis (*Carstensen et al. 2001*) looked at the impacts from freight shipping and ferry operations and included employment, output, income, value added, and taxes, all in terms of direct, indirect, and induced impacts. This evaluation relied on the REMI and IMPLAN models.

Through this scan, certain patterns emerge. The assessments reviewed all involve considering direct, indirect, and induced impacts and generally tend to focus on four types of metrics: employment, revenue, income, and taxes.

3.5 MULTIMODAL PRIORITIZATION, INCLUDING FREIGHT

NCFRP 12 (*Cambridge Systematics et al. 2011*) looked at how to estimate benefits of freight projects to line up private sector and public sector investments and planning. They identified four impact parties including those who own/maintain infrastructure, those who provide service, those who use infrastructure, and the rest of the community. They consider direct and indirect financial impacts are important along with other nonfinancial impacts. They identify pertinent costs and benefits including capital, maintenance and operating costs along with reliability, mobility, safety/security, economic development and revenue, and environmental benefits. Table 3.2 summarizes the costs and benefits and how they relate to the different impact parties.

Table 3.2: Stakeholder types and benefits (*Cambridge Systematics et al. 2011*, p. 24)

Benefit Category	Type of Beneficiary: Asset Provider	Service Provider	End User	Other Impacted Party
Cost Factors				
Facility Capital Costs	●	○	○	○
Facility Maintenance Costs	●	○	○	○
Operating Costs	●	●	○	○
Benefit and Other Impact Factors				
Capacity (Includes Bottleneck Congestion)	●	●	○	◑
Loss and Damage	○	◑	●	○
Scheduling and Reliability	○	●	●	○
Business Productivity	○	○	●	○
Tax Revenue	○	○	○	●
Wider Economic Developments	○	○	◑	●
Safety	◑	◑	◑	●
Environmental Quality, Sustainability, or Energy Use	◑	◑	◑	●

Key: Less Important ○ → ◑ → ● More Important

NCFRP 12 (*Cambridge Systematics et al. 2011*) also reviews case studies, including a case study of the Port of Portland, which operates air and marine ports in Portland along with industrial parks. The report outlines their project evaluation tool, which is used to organize the merits of the proposed projects, but not ultimately select them (Table 3.3). Selection is completed by "a series of teams and commissions" and final responsibility lies with the port directors and port commission (p. 33).

Table 3.3: Port of Portland project evaluation and ranking tools (*Cambridge Systematics et al. 2011*, p. 34)

Rankings	Description
Priority Index	
High	Projects that are critical to meet legal, regulatory, and customer contractual commitments and that the port already has approved
Medium	Projects that address the specific business plan of the department and are needed to maintain and build the port's assets
Low	Projects that are discretionary in nature and are not vital to maintain the health of the organization
Category Index	
Category 1	Legal/regulatory/contractual/mandate
Category 2	Maintenance/replacement
Category 3	Business development (discretionary)
Category 4	Indirect benefit to the port (benefits to the community or region)
Project Status	
Open	Projects that are approved for expenditure
Candidate Yes	Projects that have resources devoted to them to develop their business case
Candidate No	Projects that are primarily theoretical, with no business case or quantitative data to support them

Protopapas et al. (*2012*) developed performance measures to support multimodal freight comparisons between inland towing, rail and trucking. The performance measures included cargo capacity, traffic congestion, energy efficiency, air quality, safety, and infrastructure and were developed per ton-mile to allow for modal comparisons.

Transportation Economics & Management Systems Inc. & HNTB (*2006*) looked into the impacts to the midwest region for investing in rail and relied on both a benefit-cost tool and an economic input-output model. Benefits included reduction in travel times, emissions, and costs across modes due to congestion reductions and modal switch to rail. They considered highway and air as competing modes, so this project did have a multimodal component, though as with many was focused on passenger travel. Costs focused on infrastructure or capital costs, track maintenance costs, and operating and maintenance costs for the rail system. An economic rent model was developed to estimate the economic impacts from the project.

In 2001, NCHRP Project 20-29(2) worked to develop a tool for multimodal, multicriteria transportation investments for freight and passenger travel (*Roop and Mathur 2001*). The resulting software – the Transportation Decision Analysis Software (TransDec) – is currently available from McTrans but does not appear to be in use by any DOT that we have identified. The software allows consideration the following goals and objectives (p. 3): improve mobility, improve connectivity, increase cost-effectiveness, increase energy efficiency, improve air quality, reduce resource impact, reduce noise impact, improve accessibility, reduce

neighborhood impact, and improve the economy. These goals are implemented within the following framework (p. 3):

1. Identify overall transportation goals
2. Identify project evaluation objectives for each goal
3. Assign a measure to each objective
4. Assign a rating scale to each objective's measure
5. Identify investment alternatives
6. Attach a weight to each of the objectives
7. Normalize the data
8. Perform sensitivity analysis

While technically developed to support multimodal investments in passenger travel, the Multimodal Investment Choice Analysis (MICA) (*Young et al. 2002*) structure can be used to evaluate freight projects. This tool was developed for WSDOT but has never been put into practice. It suggested having both standard global variables for all projects and modal-specific variables that support evaluation of monetary and non-monetary impacts at the project and scenario level. Monetary impacts are drawn from user operating impacts, environmental impacts, and safety impacts and are categorized as capital, operating, maintenance and environmental costs assigned to DOT, federal, private, or local costs. Non-monetary impacts include raw versions of the monetary costs (for example, instead of calculating the financial impact of the total number of crashes, the total number of crashes itself is tracked) and the results of Outcome Objectives – qualitative concerns including Communities, Economic Development, Environment, along with various statewide/multimodal outcomes and various service objectives.

TIGER Discretionary Grants require completing a BCA for all applications regardless of the mode or scale. These grants apply to freight and passenger travel. The BCA does not provide specific methodology, but does provide a consistent set of benefits suitable for all modes. (*USDOT 2013a, USDOT 2013b*)

3.6 SUMMARY

Most methods to include freight in project prioritization seem to focus on benefits from freight for projects and do not always consider the costs of the projects. For this reason, it is challenging to truly develop a prioritization method sensitive to both that would easily allow freight-specific projects to be compared to one another. BC ratios are used frequently in project prioritization schemes, generally, but those methods focus on passenger travel. Quantifying freight benefits allows consideration of the impact projects have on freight, but including those values in a BC ratio may involve double counting since they may already be included within the general evaluation. Separate BCA can be completed for freight projects, but highway freight projects will still struggle to tease out what counts as a freight benefit or cost and what is assigned to passenger travel. For example, a benefit-cost ratio which includes travel time estimated from a travel demand model would generally include the travel time impacts on all road users; also including the specific travel time impacts on freight vehicles would account for those impacts twice within the system. Likewise, especially for highway projects, allocating the costs between the different modes is challenging. Thus, developing a freight-specific benefit-cost ratio that considers projects in different modes (rail, air, water, highway) may be achievable for projects that more closely benefit freight such that nearly all costs can be assigned to the freight users, but projects that benefit a wide cross section of users are not so cleanly assessed. One potential solution is to more discretely quantify the benefits for all stakeholders of all projects. The costs could then be allocated proportionally or the entire cost of a project could be compared to a particular stakeholder's benefit to understand the value of that project to that user group.

Further, the vast majority of project prioritization tools focus on roadway travel. Few resources exist that provide insight into the prioritization of non-truck freight modes, or how to compare the value between modes.

4.0 METHODS SELECTED FOR DETAILED EVALUATION AND SUPPORTING RATIONALE

In Chapters 2.0 and 3.0, methods for prioritizing freights projects were identified. These methods were either ones in use by public agencies or were proposed in the academic literature. In preparation for Chapter 5 – an analysis of the limitations of comparison across modes, 9 quantitative methods have been identified for detailed analysis. While project prioritization in general is a complex process which can often involve qualitative components such as stakeholder opinion, the remaining chapters will focus on the quantitative methods used to inform project prioritization processes. The survey of the available methods completed in Chapters 3 and 4 illustrated two general types of quantitative tools widely utilized: scorecard evaluation and benefit-cost analysis. This chapter will outline examples of each method to be examined in more detail in Chapter 5. These examples are ones available with adequate information to inform their critique. While some are explicitly freight tools, many are general transportation prioritization methods in which freight is a component.

4.1 FIVE SELECTED SCORECARD METHODS

Scorecard methodologies for project prioritization usually involve the identification of criteria for scoring (such as environmental/emissions impact, congestion reduction, economic impact, safety, mobility, etc.) and then evaluators assign each identified criteria a score or weight to come up with an overall "score" for prioritization.

Sometimes the scorecard approaches are quite specific as to how scores are assigned (and it may use results from benefit/cost analysis) and in other cases evaluators merely check off whether they think a criteria has been met. The big advantage of the scorecard approach is it is often easier for stakeholders to understand the evaluation methodology. However, even after the application of the scorecard methodology, the final prioritization may ultimately use the score as only one of several pieces of information in the decision-making process.

The following five cases were chosen as they were scorecard methods for which an adequate amount of methodological detail was available. They also all appear to have a freight component and also are the most developed in terms of having details on criteria, performance measures, scoring and weights. The following five are the best available and are geographically diverse.

4.1.1 Maryland DOT Scorecard

Maryland's DOT has a well-documented scorecard which is used for transportation projects, including freight project prioritization for Highway and Rail modes. According to the Maryland Statewide Freight Plan, marine projects are presented with the same scorecard approach. They use one scorecard for all modes and do not differentiate by mode. They include a criteria specific to freight: "connectivity for freight mobility". The Maryland methodology method was selected because it is multimodal and well-documented.

4.1.2 Ohio DOT Scorecard

Ohio DOT uses a scorecard for all DOT projects, though the most evidence was found for highway projects. Freight is a factor within transportation and is weighted accordingly. As in most of the scorecard methods, VMT reduction is considered in the project evaluation process.

4.1.3 Puget Sound Regional Council Transportation Projects Scorecard

PSRC has a standard scorecard method used for all transportation projects that includes freight as a criterion. They have available documentation and use both a scorecard and benefit-cost analysis in their project prioritization although how the two methods are combined is not entirely clear. The use of both methods can provide a useful comparison of how the two methodologies are used.

4.1.4 Florida DOT Rail and General Highway Scorecards

Florida maintains distinct scorecards for rail and for general highway modes, rather than a single DOT-wide method. This example illustrates the difficulties encountered when trying to create meaningful methods for evaluation of modes that may be quite different. Florida's methods are well-documented with all necessary weights and measures explained.

4.1.5 Missouri DOT Long Range Transportation Plan

Missouri's DOT has a reasonably well-documented scorecard which is used for transportation projects. Similar to Maryland, one scorecard is used for all modes, although the methodology is applied mostly to highway projects.

4.2 FOUR SELECTED BENEFIT-COST IMPLEMENTATIONS

4.2.1 TIGER Grants Benefit-Cost Analysis

Starting in 2009, as part of the American Recovery and Reinvestment Act, funding was made available for transportation improvement projects nationwide through the TIGER program. Each year since, additional funds have been available which are awarded on a competitive basis. The foundation of the evaluation criteria is a benefit-cost analysis. As with the New Zealand evaluation criteria, because this method is applied nation-wide, is applied to a variety of transportation projects, and numerous examples are available, it provides an excellent case study.

4.2.2 Federal Aviation Authority Cost Benefit Analysis Guide

The FAA provides a detailed benefit-cost analysis guide. In addition to including adequate detail for a thoughtful evaluation, this example illustrates the type of tool used when evaluation is restricted to one mode. Further, it ensures inclusion of a detailed evaluation of benefit-cost for a non-roadway mode.

4.2.3 Washington State Department of Transportation Truck Freight Highway Benefit-Cost Methodology

WSDOT has developed a benefit-cost methodology for considering truck freight highway projects. This tool is included is our case studied as it is freight-specific, state-wide, and adequately documented.

4.2.4 Puget Sound Regional Council Benefit-Cost Analysis

PSRC uses a benefit-cost analysis tool as part of its evaluation criteria for projects. This tool is included as a case study for a handful of reasons. First, it provides a useful contrast to their scorecard evaluation they also widely utilize. Second, it is well documented and regionally sensitive. Third, while it is used to evaluate all transportation projects, it does account for freight and also includes environmental indicators.

4.3 CONCLUSION

The methods presented above will be examined in detail within Chapter 5 to identify their decision components, the limitations to their implementation, and their cost and emissions results. While we have made every attempt to include multimodal methods and represent a diversity of modes, it is not necessary possible to include multiple examples of each mode given the limited instances of well-documented methods. The included methods represent an important cross section and should provide enough insight to ensure all freight modes can be accounted for within the evaluation.

5.0 DESCRIPTION OF 9 SELECTED METHODOLOGIES AND THEIR LIMITATIONS FOR COMPARING RESULTS ACROSS MODES

This task will include consideration of data quality and modal operations for the nine methodologies chosen in Chapter 4. We have organized this report to include five scorecard methodologies and four benefit-cost methodologies for making decisions regarding freight related investments. The first section below describes the five scorecard methodologies and points out the limitations and problems encountered when trying to compare results across modes. The second section does the same for the four chosen benefit-cost methodologies.

5.1 SECTION 1: SCORECARD METHODOLOGIES

This section documents the five scorecard methodologies selected for analysis for this report:

- Ohio
- Maryland
- Florida
- Missouri
- Puget Sound Regional Council (PSRC)

Of these scorecard approaches to prioritization, Ohio's most clearly attempts to develop a scorecard that can be used for all transportation modes and be comparable across modes (road, intermodal, transit, intermodal and freight). Ohio thus has made the most progress in attempting to adjust measures of volume and capacity for comparing freight across modes. For example, Ohio uses TEUs as a common freight measure across modes and provides conversion factors to express truck volumes as TEUs.

All five of these scorecard approaches use criteria for ranking. Although the criteria may have different names in different agencies, most include the following:

- Safety
- Maintenance or Preservation of the System
- Environmental
- Freight Connectivity/Mobility

- Economics development
- Financial (Coordination, Project Sponsorship, etc.)
- Congestion Reduction
- Quality of Life or Communities

Although the stated criteria are similar, the interpretation, measurement, and scoring can vary widely. For instance under the Environmental criteria two states (Ohio and Florida) provide detailed calculations for reduction in emissions based on the volume of truck traffic diverted by rail projects while others simply assume that rail projects are more environmentally friendly. Florida has a very detailed description of Environmental measures and scoring, but they mostly relate to wildlife habitat, historical sites, and geology and include no measure for emissions. Maryland assumes rail is more environmentally friendly than road and uses economic development in assigning Environmental points for road in the scorecard. Thus, there are differences between agencies in interpretation and measurement of Environmental factors and also between modes.

Most (but not all) include some category for safety and security, but this category might be measured carefully by metrics like crash ratios or its evaluation may reflect an assumption that rail is safer.

As seen below, some agencies have developed very detailed measures and assigned points accordingly whereas other agencies simply have categorical "Yes or NO" answers that determine point allocation. While Missouri has a scorecard approach that includes the same criteria for all highway project types and has detailed weights assigned to each measure, many of the points are District Factors/Flexible points that are reserved for evaluators to assign as they see fit without any standardization. This reflects the observation in our survey of state DOT prioritization that even with a scorecard, stakeholder input is an important part of the process.

Details on the five scorecard approaches follow.

5.1.1 Ohio DOT TRAC Scorecard Evaluation (*OhDOT 2011*)

The state of Ohio has a Transportation Review Advisory Council (TRAC) established by the Ohio General Assembly in 1997 to develop and oversee the project selection process for major new capacity projects (defined as those over $12 million). The TRAC was created not just to deal with road and bridge projects, but to make decisions on transportation projects of regional and statewide importance (*OhDOT 2011*). The TRAC define criteria and scoring for major new capacity projects and, in doing so, give equal consideration to road, transit, intermodal and freight projects. Accordingly, the TRAC has developed a "scoring criteria that can be applied equally to any mode, or surrogate criteria so that modal benefits can be compared in an equal fashion across modes." (*OhDOT 2011*, p.8)

There are three broad Criteria (or Factors) for scoring Ohio DOT project proposals: Transportation, Community and Economic Growth and Development, and Project Sponsor

Investment. Under the Transportation Factor (Criteria), there are five sub-factors: Traffic, Benefit and Cost, Air Quality, Functional Class and Intermodal Connectivity. Community and Economic Growth and Development have four sub-factors: Adopting Appropriate Land Use Measure, Positioning Land for Redevelopment, Economics Impact, and Considering Factors of Economic Distress.

As seen inTable 5.1 Table 5.1, a total of 55 (out of 100) points are assigned to the Transportation Factors, and these points are distributed across the five sub-factors. The Community and Economic Growth and Development Criteria receive a total of 25 points, distributed between the four sub-factors. Finally, for each project 20 points are assigned to Project Sponsor Investment Factors. Thus, the broad criteria are weighed 55-25-20, with the transportation factor category receiving the greatest weight.

Table 5.1: Major New Project Scoring Criteria (*OhDOT 2011*, p. 8)

Major New Project Scoring Criteria				
Transportation Factors				
Evaluation Factors	**Road**	**Transit**	**Freight**	**Points**
Traffic	V/C Ratio	Existing Peak Hour Ridership/Capacity	Existing Freight Volume/Capacity	10
	Safety	Proposed Peak Hour Capacity Increase	Proposed Freight Capacity Increase	10
	ADTT	VMT Reduction	Truck Reduction	5
Benefit and Cost	Benefit/Cost	Cost/VMT Reduction	Cost/Truck Reduction	10
Air Quality	Emission Reduction			5
Functional Class				10
Intermodal Connectivity				5
			Total Transportation Points Available:	**55**
Community and Economic Growth and Development Factors				
Adopting Appropriate Land Use Measures				4
Positioning Land for Redevelopment				6
Economic Impact – Return on Investment				10
Considering Factors of Economic Distress				5
			Community & Economic Growth and Development Points Available:	**25**
Project Sponsor Investment Factors				
Project Sponsor Investment as percentage of total Project Cost				**20**
			Total Points Available:	**100**

Since Transit is beyond the scope of this study, the measures used to assess and assign points are described below for the Road and Freight Categories.

5.1.1.1 Transportation Factors (55 points)

1. Traffic (25 points)

For road projects, the volume to capacity ratio (v/c) is a standard indicator of congestion used in the industry; the closer the v/c ratio is to one, the higher the level of congestion on the road. Accordingly, for road projects, the 10 points allocated to traffic volume is determined by the v/c ratio as shown in Table 5.2.

Table 5.2: v/c Ratio Scoring (*OhDOT 2011*, p. 13)

Intermodal Freight Congestion: V/C Ratio Scoring	
V/C	**Points**
0	0
0.55	1
0.60	2
0.65	3
0.70	4
0.75	5
0.80	6
0.85	7
0.90	8
0.95	9
1.00+	10

For freight transportation projects, the Ohio DOT provides guidelines for computing volume to capacity (v/c) ratios for road, port, rail, and intermodal projects so that Table 5.2 can be used to assign points for v/c for all the modes using the same scale. To do this intermodal comparison, a twenty-foot equivalent unit (TEU) is assumed to be a comparable measure across modes that approximate the volume of 20 foot long containers that could be used on a ship, a truck, or on a train. TEUs are thus used to standardize the volume of freight across modes using the v/c equivalency factors shown in Table 5.3.

Table 5.3: v/c Ratio Equivalency Factors (*OhDOT 2011*, p. 13)

Equivalent Factors for Evaluating Volume-to-Capacity Ratio for Different Modes of Freight Transportation				
	Road	**Port**	**Railroad**	**Intermodal Terminal**
Volume Inputs	Traffic volume: ▪ Autos ▪ Trucks ▪ Peak hour factor	Port volume: ▪ Break bulk tons ▪ Containers (TEUs) ▪ Dry bulk tons ▪ Liquid bulk gallons	Train traffic, expressed as: ▪ No. of railcars ▪ No. of trains ▪ Train length	Terminal throughput: ▪ Containers (TEUs) ▪ Other transfer measure (e.g., rail/barge, rail/truck)
Capacity Inputs	▪ Type of road ▪ Number of lanes ▪ Speed limit ▪ Terrain ▪ % truck traffic ▪ Etc.	Per hour or per diem capacity expressed in tons, TEUs, etc.	Per hour or per day capacity (expressed in railcars, trains, etc.), as controlled by: ▪ No. of tracks ▪ Signalization ▪ At grade crossings	Per hour or per day transfer capacity, for example, containers (TEUs) per day.

The second sub-factor in Traffic is defined differently for Road projects and for Freight projects. For Road projects it is called Safety and is allocated 10 points, depending on the crash frequency/density, severity, crash rate. The crash frequency is defined as the number of crashes occurring at an intersection; the density is the number of crashes per mile on a highway segment and is worth up to 3 points. Crash severity is worth up to 4 points and depends on the societal cost of the crash. Crash rate is define as the number of crashes per million vehicular miles along a route and is worth up to 3 points (See Table 5.4).

Table 5.4: Road Safety Criteria Scoring (*OhDOT 2011*, p.10)

Safety Criteria Scoring					
Crash Frequency/Density	**Points**	**Relative Severity Index**	**Points**	**Crash Rate**	**Points**
0 – 29	0	0 - 19,999	0	0 – 0.99	0
30 – 59	1	20,000 - 24,999	1	1 – 1.99	1
60 – 89	2	25,000 – 29,999	2	2 – 2.99	2
90+	3	30,000 – 34,999	3	3+	3
		35,000+	4		

For freight projects, safety does not appear to enter into this scorecard in a similar manner to road projects. Rather, for freight 10 points are allocated to the freight capacity increase associated with a project rather than to safety factors. No explanation is offered for the asymmetry in treatment. Freight capacity is again based on TEUs of freight. The

expected increase in TEUs of freight that will be handled with the new capacity are estimated then points are allocated according to Table 5.5.

Table 5.5: Freight Capacity Increase (*OhDOT 2011*, p. 14)

Freight Capacity Increase	
TEU's per Day	**Points**
0 - 50	0
60 - 99	1
100 - 149	2
150 - 199	3
200 - 249	4
250 - 299	5
300 - 349	6
350 - 399	7
400 – 449	8
450 – 499	9
500+	10

The final sub-factor under Traffic is volume-related and is allocated 5 points. For Road projects, volume is measured by the Average Daily Truck Traffic (ADTT) and points are assigned according to those shown in Table 5.6.

Table 5.6: Average Daily Truck Traffic (ADTT) Scoring (*OhDOT 2011*, p. 10)

ADTT Scoring	
ADTT	**Points**
0-2,400	1
2,401 – 4,800	2
4,801 – 7,200	3
7,201 – 9,600	4
9,601 +	5

For Freight projects, the reduction in Truck Miles Travelled (TMT) is considered (this is used for port and rail freight projects). The volume of freight moving by rail or by barge can be measured in terms of TEUs, which are equivalent to one truck trailer. The new freight capacity in TEUs created by the port or rail project is thus assumed to be the total TMT reduction at the level of project. If the project is at the MPO (state) level, then the TMT is calculated only within the boundaries of the MPO (state) (*OhDOT 2011*, p. 14). Points are awarded according to the estimated reduction in truck miles travelled, as shown in Table 5.7.

Table 5.7: Reduction in Truck Miles Travelled (*OhDOT 2011*, p. 14)

Reduction in Truck Miles Travelled	
TMT Reduction	**Points**
0 – 2,499	0
2,500 – 24,999	1
25,000 – 49,999	2
50,000 – 74,999	3
75,000 – 99,999	4
100,000 +	5

2. Benefit and Cost (10 points)

The second sub-factor under Transportation is the Benefit and Cost measure which is defined as the Benefit –Cost Ratio for the project for Road Projects and as the Cost of TMT reduction for Freight projects.

The cost of TMT reduction is defined as the unit cost of removing one mile of truck travel and replacing it with air, water or rail travel (*OhDOT 2011*, p. 15). ODOT's policy on measuring the cost of TMT reductions is to calculate the total cost of the stand-alone project (as opposed to a project segment) and divide by the expected reduction in TMT (Conversation with Scott Phinney 6/25/13). Points are assigned according to the Road and Freight Portions of Table 5.8.

Table 5.8: Transportation Benefit and Cost Scoring (*OhDOT 2011*, p. 15)

Transportation Benefit and Cost					
Roadway		**Transit**		**Freight**	
Benefit/Cost	**Score**	**Cost/VMT**	**Score**	**Cost/TMT**	**Score**
0.00-0.74	0	$5.00+	0	$20.00+	0
0.75-0.99	1	$4.50-$4.99	1	$18.00-$19.99	1
1.00-1.24	2	$4.00-$4.50	2	$16.00-$17.99	2
1.25-1.49	3	$3.50-$3.99	3	$14.00-$15.99	3
1.50-1.74	4	$3.00-$3.50	4	$12.00-$13.99	4
1.75-1.99	5	$2.50-$2.99	5	$10.00-$11.99	5
2.00-2.24	6	$2.00-$2.50	6	$8.00-$9.99	6
2.25-2.49	7	$1.50-$1.99	7	$6.00-$7.99	7
2.50-2.74	8	$1.00-$1.50	8	$4.00-$5.99	8
2.75-2.99	9	$0.50-$0.99	9	$2.00-$3.99	9
3.00	10	$0.00-$0.49	10	$0.00-$1.99	10

3. Air Quality (5 points)

Air quality is interpreted as the reduction in emissions attributable to the project. In the air quality score the Ohio DOT considers the reduction in fuel consumption (2.5 points) and the reduction in Ozone Precursors (2.5 points). For Road projects air quality factors are based on build and no-build options, and the state travel demand forecasting model is used to get values. For Freight projects, standard emissions rates are applied to the reduction in TMT to get the air quality factor. No specific values are given for the allocation of the 5 points.

4. Functional Classification (10 points)

Scores are awarded to projects depending on the road functional class as defined in Table 5.9.

Table 5.9: Functional Classification (*OhDOT 2011*, p. 16)

Functional Classification Scoring	
Class	**Points**
Local	0
Collector	2
Minor Arterial	4
Principle Arterial	6
Freeway or Expressway	8
Interstate	10

For non-truck modes, the road class most impacted by the improvement will be used to score the project (*OhDOT 2011*, p. 16).

5. Intermodal Connectivity (5 points)

A project will receive up to 5 points for intermodal connectivity if all or part of its purpose and need involves connecting two or more modes of transportation (*OhDOT 2011*, p. 17). For freight projects, the goal is to make the state a destination for freight and encourage development of freight logistics systems rather than simply moving freight through the state.

5.1.1.2 Community and Economic Development Factors (20 points)

1. Adopting Appropriate Land Use Measures (4 points)

The four points here are allocated (one point apiece), if:

- There is a comprehensive land use plan in the affected area
- The land use plan is coordinated with transportation
- The city or county has zoning appropriate to the project
- The project is part of an MPO plan OR for projects outside MPOs, part of a regional or statewide plan.

2. Positioning Land for Redevelopment (6 points)

The percent of developed land within the geographic region served by the project determines the number of points allocated to the project. The point scale is listed in Table 5.10.

Table 5.10: Positioning for Land Development (*OhDOT 2011*, p. 18)

Positioning Land for Redevelopment	
Percentage of "Developed" Land Served by the Project[1]	**Points**
Less than 60%	0
61 – 65	1
66 – 70	2
71 – 75	3
76 – 80	4
81 – 85	5
86% +	6
[1]Geographic area as defined by project applicant, or as default, within one mile of the project.	

3. Economic Impact-Return on Investment (10 points)

The State Department of Development in coordination with the TRAC assigns up to ten points to the project for this factor.

4. Considering Factors of Economic Distress (5 points)

The TRAC will assign up to 5 points to a project depending on the level of distress measured as a combination of the poverty rate and the unemployment rate in what is considered to be the relevant geographic area. The point scale is listed in Table 5.11.

Table 5.11: Economic Distress Scoring (*OhDOT 2011*, p. 20)

Economic Distress Scoring			
County's 5-year average unemployment rate in relation to state average	**Points**	**County's 5-year average poverty rate in relation to state average**	**Points**
1 – 10% greater	0.5	1 – 10% greater	0.5
10.1 – 20% greater	1	10.1 – 20% greater	1
20.1 – 25% greater	1.5	20.1 – 25% greater	1.5
25.1 – 30% greater	2	25.1 – 30% greater	2
Greater than 30.1%	2.5	Greater than 30.1%	2.5

5.1.1.3 Project Sponsor Investment Factors (20 points)

In an effort to maximize the potential for investment dollars, the Ohio DOT awards more points to projects that have a greater percentage of local financing. The exact number of points awarded is shown in Table 5.12.

Table 5.12: Project Sponsor Investment Factor Points (*OhDOT 2011*, p. 21)

Maximizing Public Investment	
Local investment as percent of total project cost	
0 – 14%	0
15 – 19%	5
20 – 24%	10
25 – 29%	15
30% +	20

5.1.1.4 Summary/Analysis

The scorecard methodology used by Ohio's DOT for major new capacity projects has clearly been developed to allow for comparison of projects across modes. This is most evident in the transportation factors which include standardization of units for comparisons across freight modes. The weakest part of the comparison is in the calculation of and assumption that a TMT reduction on roads will occur when projects for other freight modes are undertaken. While some mode shifting is likely, additional capacity in non-road alternatives for freight might increase the amount of freight moving through the state (with resultant benefits) but have little impact on road use. Compounding this flaw, the mode shift TMT reduction assumption is further used in the evaluation of the impact of investments on air quality and emissions.

Another asymmetry in the treatment of modes is in the consideration of safety criteria for road projects but not for the other modes. Instead, other modes consider their expected increase in capacity. This treatment implies that increases in capacity for non-road freight will relieve the use of road and therefore increase road safety. This may be due to limitations on comparable safety data across modes.

5.1.2 Florida DOT Scorecard Evaluation

In Florida, both the highway and rail divisions of Florida DOT (FLDOT) have scorecards for investment prioritization. Although the state does not currently prioritize across modes, these prioritization scorecards represent a concerted effort to make consistent freight investment decisions system-wide.

The Criteria (or Goals) for rail and highway projects differ only slightly as both have been developed to align with the long-term goals of FLDOT.

The five criteria used to evaluate highway transportation infrastructure improvements are:

- Safety and Security
- System Preservation
- Mobility
- Economics
- Quality of Life

The five "ideal" Criteria identified for rail are:

- Safety and Security
- Maintenance and Preservation
- Mobility and Economic Competitiveness
- Quality of Life and Environmental Stewardship
- Sustainable Investments

The first four rail criteria essentially cover all five of those specified for highway. The Mobility and Economics criteria for highway are combined into one criterion for rail (Mobility and Economic Competitiveness). Similarly, Quality of Life is a criterion for highway project prioritization, while the parallel rail criterion is Quality of Life and Environmental Stewardship.

The major difference is prioritization for rail, which has traditionally been funded mostly by the private sector, is more sensitive to the potential need to operationalize the projects placed on the needs list. Indeed, the Rail System Plan contains a caveat that states:

> *"It is important to note that inclusion of a need in the Investment Element of the Florida Rail Plan System does not constitute a commitment on the part of the Florida Department of Transportation (FLDOT) or the State of Florida to provide funding."(FLDOT 2010b, p. 5-2)"*

Accordingly, the "Sustainable Investments" criterion for rail focusses on funding.

The other main difference between the highway and rail prioritization scorecard approaches for Florida is while highways evaluations have performance measures for each criterion and have specific scores and weights assigned to each, rail prioritization does not actually use the identified "ideal" criteria and performance measures but rather uses a list of practical and available scoring metrics and performance measures for prioritization.

5.1.2.1 Highway

Table 5.13 provides a list of performance measures used to evaluate each of the five criteria for highway investments. Each criterion is equally weighted in this scorecard, receiving 20 points. The performance measures listed under each are given different scores and thus are weighed differently within a criterion.

Table 5.13: Highway Criteria and Performance Measures (*FLDOT 2008*, p. 3-3)

Goal Measured	Measure	Maximum Score
Safety and Security	Crash Ratio	10
	Fatal Crash	4
	Bridge Appraisal Rating	3
	Link to Military Base	3
	Possible Subtotal	***20 points***
System Preservation	Volume /Capacity (v/c) Ratio	10
	Truck Volume (AADTT)	6
	Vehicular Volume (AADT)	2
	Bridge Condition Rating	2
	Possible Subtotal	***20 points***
Mobility	Connector Location	1
	Volume /Capacity (v/c) Ratio	4
	Truck Volume (% Trucks)	2
	Vehicular Volume (AADT)	2
	System Gap	2
	Change in v/c -LOS (for Mainline segments only) Interchange Operations (for Interchanges only)	3
	Bottleneck/Grade Separation	2
	Delay	4
	Possible Subtotal	***20 points***
Economics	Demographic Preparedness	5
	Private Sector Robustness	5
	Tourism Intensity	5
	Supporting Facilities	5
	Possible Subtotal	***20 points***
Quality of Life	Land and Social Criteria	4
	Geology Criteria	4
	Habitat Criteria	4
	Water Criteria	8
	Possible Subtotal	***20 points***
	Total Maximum Score	**100 points**

The following explains how the measures are calculated and how points are assigned for each of the five criteria. In some cases the rating/scoring rubric is extremely detailed so the Tables from the FLDOT publication (*FLDOT 2008*) are reproduced rather than trying to provide verbal explanations of each.

1. Safety and Security

Four measures are used to get a Safety and Security score:

- crash ratio (10 points maximum)
- fatal crash (4 points maximum)
- bridge appraisal rating (3 points maximum)
- link to military base (3 points maximum)

The **Crash Ratio** is calculated as:

$$Crashes\ per\ Mile = \frac{\sum Crashes}{projectLength}$$ **(*FLDOT 2008*,p. A-5)**

The points are assigned to this measure using Table 5.14. Segments with higher crash ratios get more points.

Table 5.14: Crash Ratio Scoring (*FLDOT 2008*, p. A-3)

SCORE	CRATIO
	Crash Ratio
10	Ratio > 3.66
8	2.59< Ratio <= 3.66
6	2.00< Ratio <= 2.59
4	1.63< Ratio <= 2.00
2	1.33< Ratio <= 1.63
1	1.0< Ratio <= 1.33
0	Ratio <= 1.0 = 0

Fatal Crashes are assigned a maximum of 4 points according to Table 5.15.

Table 5.15: Fatal Crash Scoring (*FLDOT 2008*, p. A-5)

SCORE	TOT_FATL
	Fatal crashes / mile
4	crash/mile > 5
3	4 < crash/mile <=5
2	3 < crash/mile <=4
1	2 > crash/mile <= 3
0	crash/mile <= 2

Bridge Deficiency: For bridge appraisal scoring, FLDOT uses the results from its bridge inspection process to assign points as shown in Table 5.16. A rating of 3 is the most deficient bridge category and receives the highest score (3 points), an adequate bridge receives an inspection rating of 0 and thus would receive 0 points.

Table 5.16: Bridge Deficiency Scoring (*FLDOT 2008*, p. A-7)

SCORE	DKGEOM
	Deck Geometry Rating
3	Rating = 3
2	Rating = 2
1	Rating = 1
0	Rating = 0 or N

Link to a Military Base: 3 points are assigned if the project is within 10 miles of a military base, 0 points are awarded otherwise. (*FLDOT 2008*, p. 3-5*)*.

2. System Preservation

Four performance measures are used in this category: The v/c ratio, Average Annual Daily Truck Traffic (AADTT), Average Annual Daily Traffic (AADT) and a Bridge Condition Rating. The v/c ratio receives a potential of half of the category's 20 points.

The v/c ratio reflects congestion, and points are allocated as shown in Table 5.17.

Table 5.17: v/c Ratio Scoring (*FLDOT 2008*, p. B-3)

SCORE	VC_RATIO
	v/c For WP & CFP
10	v/c > 1.75
7	v/c > 1.50 and <= 1.75
4	v/c > 1.25 and <= 1.50
2	v/c > 1.00 and <= 1.25
0	v/c <= 1.00

The **AADTT** measure receives a maximum of 6 points with scores of 0, 3, or 6 depending on truck volume and road classification. See Table 5.18 (two sets of scoring are provided, one using the working plan (WP) and the other using the predicted cost feasible plan (CFP)):

Table 5.18: Truck AADTT (WP is from a previous working plan, CFP is the predicted cost feasible plan) (*FLDOT 2008*, p. B-5)

WP AADTT:

SCORE	Truck AADTT (by PRIOCAT)					
	1	2	3	4	5	6
	Urban Arterial	*Urban Highway*	*Urban Freeway*	*Rural Arterial*	*Rural Highway*	*Rural Freeway*
6	> 6,688	> 7,177	> 17,501	> 4,804	> 4,248	>16,154
3	> 3,245 and <= 6,688	> 3,641 and <= 7,177	> 7,488 and <= 17,501	> 2,768 and <= 4,804	> 1,846 and <= 4,248	> 9,284 and <= 16,154
0	< 3,245	< 3,641	< 7,488	< 2,768	< 1,846	< 9,284

CFP AADTT:

SCORE	Truck AADTT (by PRIOCAT)					
	1	2	3	4	5	6
	Urban Arterial	*Urban Highway*	*Urban Freeway*	*Rural Arterial*	*Rural Highway*	*Rural Freeway*
6	> 7,967	> 8,988	> 21,226	> 5,939	> 5,440	> 20,036
3	> 3,835 and <= 7,967	> 4,434 and <= 8,988	> 9,414 and <= 21,226	> 3,378 and <= 5,939	> 2,248 and <= 5,440	> 11,419 and <= 20,036
0	< 3,835	< 4,434	< 9,414	< 3,378	< 2,248	< 11,419

The **AADT** measure considers the total volume of traffic and receives a maximum of 2 points, depending on road classification. This measure is reported for both WP and CFP scenarios. Points are reported in Table 5.19 according to AADT and road classification.

Table 5.19: Vehicle AADT (*FLDOT 2008*, p. B-7)

WP AADT:

SCORE	AADT (by PRIOCAT)					
	1	2	3	4	5	6
	Urban Arterial	*Urban Highway*	*Urban Freeway*	*Rural Arterial*	*Rural Highway*	*Rural Freeway*
2	> 70,151	> 69,745	> 217,227	> 39,058	> 25,887	> 91,491
1	> 37,049 and <= 70,151	> 37,798 and <= 69,745	> 100,710 and <= 217,227	> 25,848 and <= 39,058	> 14,158 and <= 25,887	> 37,049 and <= 55,271
0	< 37,049	< 37,798	< 100,710	< 25,848	< 14,158	< 55,271

CFP AADT:

SCORE	AADT (by PRIOCAT)					
	1	2	3	4	5	6
	Urban Arterial	*Urban Highway*	*Urban Freeway*	*Rural Arterial*	*Rural Highway*	*Rural Freeway*
2	> 82,496	> 88,001	> 260,251	> 49,454	> 33,283	> 115,462
1	> 43,478 and <= 82,496	> 46,166 and <= 88,001	> 123,007 and <= 260,251	> 31,571 and <= 49,454	> 17,240 and <= 33,283	> 68,186 and <= 115,462
0	< 43,478	< 46,166	< 123,007	< 31,571	< 17,240	< 68,186

Finally, the **Bridge Condition Rating** is awarded a maximum of 2 points. These points are not based on the overall bridge condition, but instead consider individual components of the bridge structure with the score based on the most deficient component. The values for the Bridge Condition measure are shown in Table 5.20.

Table 5.20: Bridge Condition (DK is deck, SUP is superstructure, SUB is substructure and CULV is culvert) - (*FLDOT 2008*, p. B-9).

SCORE	DKCOND	SUPCOND	SUBCOND	CULVCOND
	Deck Condition Rating (take highest score of 4 measures)			
2	Rating = 2	Rating = 2	Rating = 2	Rating = 2
1	Rating = 1	Rating = 1	Rating = 1	Rating = 1
0	Rating = 0 or N	Rating = 0 or N	Rating = 0 or N	Rating = 0 or N

3. Mobility

This category has eight performance measures, ranging in point value from 1 to 4 (for a total of 20 points). The eight measures are:

- Connector Location (1 point)
- Volume/Capacity (v/c) Ratio (4 point maximum)
- Truck Volume (% Trucks) (2 point maximum)
- Vehicular Volume (AADT) (2 point maximum)
- System Gap (2 point maximum)
- Change in v/c or LOS (for mainline segments only) or Interchange Operations (for interchanges only) (3 point maximum)
- Bottleneck / Grade Separation (2 point maximum)
- Delay (4 point maximum)

Connector Location is awarded one point if the project is on a connection between Strategic Intermodal System (SIS) corridors or between a SIS Hub and a SIS corridor. No points are awarded otherwise.

Volume/Capacity (v/c) Ratio is identical to the v/c ratio discussed in the System Preservation Criterion performance measure. However, the v/c ratio contributes a maximum of only 4 points to the Mobility Goal (as opposed to 10 points toward the System Preservation Goal) as shown in Table 5.21.

Table 5.21: v/c Ratio Scores for Mobility (*FLDOT 2008*, p.C-5)

SCORE	VC_RATIO
	v/c For WP & CFP
4	v/c > 1.75
3	v/c > 1.50 and <= 1.75
2	v/c > 1.25 and <= 1.50
1	v/c > 1.00 and <= 1.25
0	v/c <= 1.00

Truck Volume is measured by the percentage of truck traffic based on functional classification of roadways. This value is calculated and the highest percentage of truck traffic receives a score of 2 as shown in Table 5.22.

Table 5.22: Truck volume as percent of traffic (*FDPT 2008*, p. C-7)

SCORE	Percent Trucks (by PRIOCAT, all listed as percentages)					
	1	2	3	4	5	6
	Urban Arterial	*Urban Highway*	*Urban Freeway*	*Rural Arterial*	*Rural Highway*	*Rural Freeway*
2	> 15.77	> 17.59	> 12.19	> 16.52	> 22.56	> 26.34
1	> 8.79 and <= 15.77	> 9.59 and <= 17.59	> 7.43 and <= 12.19	> 10.68 and <= 16.52	> 13.05 and <= 22.56	> 16.79 and <= 26.34
0	< 8.79	< 9.59	< 7.43	< 10.68	< 13.05	< 16.79

Vehicular Volume (AADT) uses a scoring metric identical to that used for Vehicular Volume (AADT) in System Preservation (see Table 5.19 above).

System Gap is awarded 2 points if a project fills a system gap and zero points are awarded otherwise. A System Gap is defined as a segment or section of a roadway that is less than 30 miles long and substantially different than the majority of the remaining roadway corridor (*FLDOT 2008*, p. 3-10).

Change in v/c for mainline segments is calculated by comparing the existing to the projected future v/c. The score given depends on the percentage of change when comparing the "existing" to a 2015 timeframe as shown in Table 5.23.

Table 5.23: Change in v/c ratio (*FLDOT 2008*, p. C-13)

SCORE	Change in v/c (percent)
3	>25%
2	10-25%
1	0-10%
0	0%

The **Interchange Operations** measure applies if the project is an interchange (as opposed to a mainline segment) and intersections or interchanges that connect two SIS facilities receive 3 points, connections between SIS and non–SIS facilities receive 2 points, others receive zero points as shown in Table 5.24.

Table 5.24: Intersection or interchange points (*FLDOT 2008*, p. C-15)

SCORE	INT_TYPE
	Interchange Type
3	SS (SIS/SIS)
2	SN (SIS/Non-SIS)
0	None

A **Bottleneck** is by definition a mobility choke point. Projects that correct a bottleneck or include a grade separation are given 2 points; 0 points are awarded otherwise.

Delay: Finally, projects with higher daily hours of delay will receive more points compared to projects where there are fewer hours of delay. The point scale is shown in Table 5.25.

Table 5.25: Delay Scoring (*FLDOT 2008*,p. C-19)

SCORE	Total Daily Delay (vehicle hours)
4	> 2,500 vehicle hours
3	> 1,000 and <= 2,500
2	> 250 and <= 1,000
1	> 0 and <= 250
0	0

4. Economics

The Economics Criterion has four equally-weighted sub-categories:

- Demographic Preparedness (5 points maximum)
- Private Sector Robustness (5 points maximum)
- Tourism Intensity (5 points maximum)
- Supporting Facilities (5 points maximum)

Demographic Preparedness includes five sub-categories: population density, work force size, educational attainment level, population growth rate and per capita income, each receiving a maximum of one point apiece. In Table 5.26, Table 5.27, Table 5.28, Table 5.29 and, Table 5.30 these five population sub-measures are reported as a proportion relative to the state as a whole, where 100 is the state average and 200 is twice the state average. For example, the Population Density sub-measure will receive a score

of 0.8 if the population density in the area is between 150 and 199 percent of the state average *(FLDOT 2008, p. 3-13)*.

Table 5.26: Population Density (*FLDOT 2008*, p. D-3)

SCORE	Population Density Measure			
	Urban Interstate	Rural Interstate	Urban Arterial/Collector	Rural Arterial/Collector
1.0	≥ 200	≥ 200	≥ 200	≥ 200
0.8	150-199	150-199	150-199	150-199
0.6	100-149	100-149	100-149	100-149
0.4	50-99	50-99	50-99	50-99
0.2	0-49	0-49	0-49	0-49

Table 5.27: Workforce Size (*FLDOT 2008*, p. D-4)

SCORE	Workforce Size Measure			
	Urban Interstate	Rural Interstate	Urban Arterial/Collector	Rural Arterial/Collector
1.0	≥ 200	≥ 200	≥ 200	≥ 200
0.8	150-199	150-199	150-199	150-199
0.6	100-149	100-149	100-149	100-149
0.4	50-99	50-99	50-99	50-99
0.2	0-49	0-49	0-49	0-49

Table 5.28: Education Attainment (*FLDOT 2008*, p. D-5)

SCORE	Educational Attainment Level Measure			
	Urban Interstate	Rural Interstate	Urban Arterial/Collector	Rural Arterial/Collector
1.0	≥ 200	≥ 200	≥ 200	≥ 200
0.8	150-199	150-199	150-199	150-199
0.6	100-149	100-149	100-149	100-149
0.4	50-99	50-99	50-99	50-99
0.2	0-49	0-49	0-49	0-49

Table 5.29: DPI – Population Growth Rate (FLDOT *2008*, p. D-6)

SCORE	Population Growth Rate Measure			
	Urban Interstate	Rural Interstate	Urban Arterial/Collector	Rural Arterial/Collector
1.0	≥ 200	≥ 200	≥ 200	≥ 200
0.8	150-199	150-199	150-199	150-199
0.6	100-149	100-149	100-149	100-149
0.4	50-99	50-99	50-99	50-99
0.2	0-49	0-49	0-49	0-49

Table 5.30: Per Capita Income (*FLDOT 2008*, p. D-7)

SCORE	Per Capita Income Measure			
	Urban Interstate	Rural Interstate	Urban Arterial/Collector	Rural Arterial/Collector
1.0	≥ 200	≥ 200	≥ 200	≥ 200
0.8	150-199	150-199	150-199	150-199
0.6	100-149	100-149	100-149	100-149
0.4	50-99	50-99	50-99	50-99
0.2	0-49	0-49	0-49	0-49

Primary Sector Robustness measures economic impacts generated by four industrial sectors in an area: freight-intensive sectors, property taxes, seaports, and military bases. The Freight Intensity and Property Tax sub-measures are reported as a percent of the state average, with a score of 100 being equal to the average. For the Seaport sub-measure, a metric value of 1 (as opposed to a score of 1) indicates the seaport activity is the same as the average activity across the state, and the metric value of 2 indicates the activity is twice the average. For Military bases, a metric value of 1 indicates the indexed average of employment and growth rate is same as the indexed state average *(FLDOT 2008*, p. 3-13*)*. Each of these four sub-measures receives a maximum of 1.25 points as indicated in Table 5.31, Table 5.32, Table 5.33, and Table 5.34.

Table 5.31: Freight Intensity (*FLDOT 2008*, p. D-9)

SCORE	Freight Transportation Intensity Measure			
	Urban Interstate	Rural Interstate	Urban Arterial/Collector	Rural Arterial/Collector
1.25	≥ 200	≥ 200	≥ 200	≥ 200
1.00	150-199	150-199	150-199	150-199
0.75	100-149	100-149	100-149	100-149
0.50	50-99	50-99	50-99	50-99
0.25	0-49	0-49	0-49	0-49

Table 5.32: Property Tax (FLDOT *2008*, p. D-10)

SCORE	Property Tax Measure			
	Urban Interstate	Rural Interstate	Urban Arterial/Collector	Rural Arterial/Collector
1.25	≥ 200	≥ 200	≥ 200	≥ 200
1.00	150-199	150-199	150-199	150-199
0.75	100-149	100-149	100-149	100-149
0.50	50-99	50-99	50-99	50-99
0.25	0-49	0-49	0-49	0-49

Table 5.33: Seaports (*FLDOT 2008*, p. D-11)

SCORE	Seaports Measure			
	Urban Interstate	Rural Interstate	Urban Arterial/Collector	Rural Arterial/Collector
1.25	≥ 2.0	≥ 2.0	≥ 2.0	≥ 2.0
1.00	1.5 - 1.99	1.5 - 1.99	1.5 - 1.99	1.5 - 1.99
0.75	1.0 - 1.49	1.0 - 1.49	1.0 - 1.49	1.0 - 1.49
0.50	0.5 - 0.99	0.5 - 0.99	0.5 - 0.99	0.5 - 0.99
0.25	0 - 0.49	0 - 0.49	0 - 0.49	0 - 0.49

Table 5.34: Military Bases (FLDOT *2008*, p. D-12)

SCORE	Military Bases Measure			
	Urban Interstate	Rural Interstate	Urban Arterial/Collector	Rural Arterial/Collector
1.25	≥ 2.0	≥ 2.0	≥ 2.0	≥ 2.0
1.00	1.5 - 1.99	1.5 - 1.99	1.5 - 1.99	1.5 - 1.99
0.75	1.0 - 1.49	1.0 - 1.49	1.0 - 1.49	1.0 - 1.49
0.50	0.5 - 0.99	0.5 - 0.99	0.5 - 0.99	0.5 - 0.99
0.25	0 - 0.49	0 - 0.49	0 - 0.49	0 - 0.49

Tourism Intensity is determined by two equally weighed components (with a maximum of 2.5 points apiece): 1) per capita sales taxes and 2) the number of visitors. Table 5.35 and Table 5.36 indicate how points are assigned using proportions relative to the state as a whole defined as in the previous tables.

Table 5.35: Tourism Intensity – Per Capita Sales Tax (*FLDOT 2008*, p. D-14)

SCORE	Per Capita Sales Tax Measure			
	Urban Interstate	Rural Interstate	Urban Arterial/Collector	Rural Arterial/Collector
2.5	≥ 200	≥ 200	≥ 200	≥ 200
2.0	150-199	150-199	150-199	150-199
1.5	100-149	100-149	100-149	100-149
1.0	50-99	50-99	50-99	50-99
0.5	0-49	0-49	0-49	0-49

Table 5.36: Tourism Industry – Number of Visitors (*FLDOT 2008*, p. D-15)

SCORE	Number of Visitors Measure			
	Urban Interstate	Rural Interstate	Urban Arterial/Collector	Rural Arterial/Collector
2.5	≥ 200	≥ 200	≥ 200	≥ 200
2.0	150-199	150-199	150-199	150-199
1.5	100-149	100-149	100-149	100-149
1.0	50-99	50-99	50-99	50-99
0.5	0-49	0-49	0-49	0-49

The **Supporting Facilities** measure accounts for students, patients in medical facilities, and technical professionals in a region and is used as a proxy for increased economic activity and thus demand for transportation facilities. "The Higher Education sub-measure is reported as a proportion of the state average, where 1 is the state average enrollment for the census tract and 4.0 is four times the state average enrollment. A Medical Center sub-metric value of 10.0 represents the state average number of hospital beds. A Tech Center sub-metric value of 10.0 indicates a concentration of technology in a census tract is the same as the state average" (*FLDOT 2008*, p. 3-14*)*. Points are assigned as indicated in Table 5.37, Table 5.38, and Table 5.39:

Table 5.37: Supporting Facilities – Higher Education (*FLDOT 2008*, p. D-17)

SCORE	Institutions of Higher Education Measure			
	Urban Interstate	Rural Interstate	Urban Arterial/Collector	Rural Arterial/Collector
2.25	≥ 4.0	≥ 4.0	≥ 4.0	≥ 4.0
1.80	3.0 - 3.99	3.0 - 3.99	3.0 - 3.99	3.0 - 3.99
1.35	2.0 – 2.99	2.0 – 2.99	2.0 – 2.99	2.0 – 2.99
0.90	1.0 – 1.99	1.0 – 1.99	1.0 – 1.99	1.0 – 1.99
0.45	0.0 – 0.99	0.0 – 0.99	0.0 – 0.99	0.0 – 0.99

Table 5.38: Supporting Facilities – Medical Centers (*FLDOT 2008*, p. D-18)

SCORE	Medical Center Measure			
	Urban Interstate	Rural Interstate	Urban Arterial/Collector	Rural Arterial/Collector
0.5	≥ 20.0	≥ 20.0	≥ 20.0	≥ 20.0
0.4	15.0 – 19.99	15.0 – 19.99	15.0 – 19.99	15.0 – 19.99
0.3	10.0 – 14.99	10.0 – 14.99	10.0 – 14.99	10.0 – 14.99
0.2	5.0 – 9.99	5.0 – 9.99	5.0 – 9.99	5.0 – 9.99
0.1	0.0 – 4.99	0.0 – 4.99	0.0 – 4.99	0.0 – 4.99

Table 5.39: Supporting Facilities – Tech Centers (*FLDOT 2008*, p. D-19)

SCORE	Tech Centers Measure			
	Urban Interstate	Rural Interstate	Urban Arterial/Collector	Rural Arterial/Collector
2.25	≥ 40.0	≥ 20.0	≥ 40.0	≥ 20.0
1.80	30.0 – 39.99	15.0 – 19.99	30.0 – 39.99	15.0 – 19.99
1.35	20.0 – 29.99	10.0 – 14.99	20.0 – 29.99	10.0 – 14.99
0.90	10.0 – 19.99	5.0 – 9.99	10.0 – 19.99	5.0 – 9.99
0.45	0.0 – 9.99	0.0 – 4.99	0.0 – 9.99	0.0 – 4.99

5. Quality of Life

Four performance sub-categories are used to measure the Quality of Life:

- Land and Social Criteria (4 points maximum)
- Geology Criteria (4 points maximum)
- Habitat Criteria (4 points maximum)
- Water Criteria (8 points maximum)

Land and Social Criteria receives up to 4 points if the project is not located within a 100 to 500 foot buffer (depending on type roadway) of productive farmland, certain land uses or protected population groups. *(FLDOT 2008*, p. 3-16*)*. The four points for this sub-criteria are distributed as up to 1 point for farm, 2 points for land use, and 1 point to social criteria. For details on scoring, see Table 5.40, Table 5.41, and Table 5.42.

Table 5.40: Land and Social Criteria - Farms (*FLDOT 2008*, p. E-3)

SCORE	Interstate, Turnpike, or Expressway (using 500' buffer in all directions from centerline or point)
1	Project area is not located within productive farmland areas.
0.5	Less than 50 percent of the project area is located within productive farmland.
0	Greater than 50 percent of the project area is located within productive farmland.

SCORE	Arterial (using 200' buffer in all directions from centerline or point)
1	Project area is not located within productive farmland areas.
0.5	Less than 50 percent of the project area is located within productive farmland.
0	Greater than 50 percent of the project area is located within productive farmland.

SCORE	Connector (using 100' buffer in all directions from centerline or point)
1	Project area is not located within productive farmland areas.
0.5	Less than 50 percent of the project area is located within productive farmland.
0	Greater than 50 percent of the project area is located within productive farmland.

Table 5.41: Land and Social Criteria – Land Use (*FLDOT 2008*, p. E-4:5)

SCORE	Interstate, Turnpike, or Expressway (using 500' buffer in all directions from centerline or point)				
	Residential Land Use (Existing Facility)	*Residential Land Use (New Facility)***	*Community Focal Points (New Facility)***	*Noise Impacted Residential Land Use (All Facilities)*	*Noise Sensitive Uses (All Facilities)*
2	Project is on existing facility and 500 foot buffer is comprised of less than 33 percent residential land use.	Project is a new facility, and 500 foot buffer is comprised of less than 33 percent residential land use.	Project is a new facility, and no community focal points are within the 500 foot buffer.	500 foot buffer is comprised of less than 33 percent residential land use (noise-related).	500 foot buffer contains no locations with noise sensitive, nonresidential uses.
1	Project is existing facility and 500 foot buffer is comprised of 33 percent to 66 percent residential land use.	Project is a new facility, and 500 foot buffer is comprised of 33 percent to 66 percent residential land use.	Project is a new facility, and at least one community focal point is within the 500 foot buffer, excluding the 200 foot buffer.	500 foot buffer is comprised of 33 percent to 66 percent residential land use (noise-related).	500 foot buffer contains one to five locations with noise sensitive, nonresidential uses.
0	Project is existing facility and 500 foot buffer is comprised of greater than 66 percent residential land use.	Project is a new facility, and 500 foot buffer is comprised of greater than 66 percent residential land use.	Project is a new facility, and at least one community focal point is within the 200 foot buffer.	500 foot buffer is comprised of greater than 66 percent residential land use (noise-related).	500 foot buffer contains five or more locations with noise sensitive, nonresidential uses.

SCORE	Arterial (using 200' buffer in all directions from centerline or point)				
	Residential Land Use(Existing Facility)	*Residential Land Use (New Facility)***	*Community Focal Points (New Facility)***	*Noise Impacted Residential Land Use (All Facilities)*	*Noise Sensitive Uses (All Facilities)*
2	Project is on existing facility and 200 foot buffer is comprised of less than 25 percent residential land use	Project is a new facility, and 200 foot buffer is comprised of less than 25 percent residential land use.	Project is a new facility, and no community focal points are within the 200 foot buffer.	200 foot buffer is comprised of less than 25 percent residential land use (noise-related).	200 foot buffer contains no locations with noise sensitive, nonresidential uses.
1	Project is existing facility and 200 foot buffer is comprised of 25 percent to 50 percent residential land use.	Project is a new facility, and 200 foot buffer is comprised of 25 percent to 50 percent residential land use.	Project is a new facility, and at least one community focal point is within the 200 foot buffer, excluding the 100 foot buffer.	200 foot buffer is comprised of 25 percent to 50 percent residential land use (noise-related).	200 foot buffer contains one to five locations with noise sensitive, nonresidential uses.
0	Project is existing facility and 200 foot buffer is comprised of greater than 50 percent residential land use.	Project is a new facility, and 200 foot buffer is comprised of greater than 50 percent residential land use.	Project is a new facility, and at least one community focal point is within the 100 foot buffer.	200 foot buffer is comprised of greater than 50 percent residential land use (noise-related).	200 foot buffer contains five or more locations with noise sensitive, nonresidential uses.

SCORE	Connector (using 100' buffer in all directions from centerline or point)				
	Residential Land Use (Existing Facility)	*Residential Land Use (New Facility)***	*Community Focal Points (New Facility)***	*Noise Impacted Residential Land Use (All Facilities)*	*Noise Sensitive Uses (All Facilities)*
2	Project is on existing facility and 100 foot buffer is comprised of less than 10 percent residential land use.	Project is a new facility, and 100 foot buffer is comprised of less than 10 percent residential land use.	Project is a new facility, and no community focal points are within the 100 foot buffer.	100 foot buffer is comprised of less than 10 percent residential land use (noise-related).	100 foot buffer contains no locations with noise sensitive, nonresidential uses.
1	Project is existing facility and 100 foot buffer is comprised of 10 percent to 20 percent residential land use.	Project is a new facility, and 100 foot buffer is comprised of 10 percent to 20 percent residential land use.	Project is a new facility, and at least one community focal point is within the 100 foot buffer, excluding the 50 foot buffer.	100 foot buffer is comprised of 10 percent to 20 percent residential land use (noise-related).	100 foot buffer contains one to five locations with noise sensitive, nonresidential uses.
0	Project is existing facility and 100 foot buffer is comprised of greater than 20 percent residential land use.	Project is a new facility, and 100 foot buffer is comprised of greater than 20 percent residential land use.	Project is a new facility, and at least one community focal point is within the 50 foot buffer.	100 foot buffer is comprised of greater than 20 percent residential land use (noise-related).	100 foot buffer contains five or more locations with noise sensitive, nonresidential uses.

Table 5.42: Land and Social Criteria - Social (*FLDOT 2008*, p. E-6:7)

SCORE	Interstate, Turnpike, or Expressway (using a one mile buffer in all directions from centerline or point)			
	Low Income Population	*Minority Population*	*Aged Population*	*Youth Population*
1	The percentage of the low income population within the one mile buffer is less than the countywide percentage for this population.	The percentage of the minority population within the one mile buffer is less than the countywide percentage for this population.	The percentage of the age 65 or older population within the one mile buffer is less than the countywide percentage for this population.	The percentage of the age 17 or younger population within one mile is less than the countywide percentage for this population.
0.5	The percentage of the low income population within the one mile buffer is between 100 percent and 149 percent of the countywide percentage for this population.	The percentage of the minority population within the one mile buffer is between 100 percent and 149 percent of the countywide percentage for this population.	The percentage of the age 65 or older population within the one mile buffer is between 100 percent and 149 percent of the countywide percentage for this population.	The percentage of the age 17 or younger population within the one mile buffer is between 100 percent and 149 percent of the countywide percentage for this population.
0	The percentage of the low income population within the one mile buffer is 150 percent or more of the countywide percentage for this population.	The percentage of the minority population within the one mile buffer is 150 percent or more of the countywide percentage for this population.	The percentage of the age 65 or older population within the one mile buffer is 150 percent or more of the countywide percentage for this population.	The percentage of the age 17 or younger population within the one mile buffer is 150 percent or more of the countywide percentage for this population.

SCORE	Arterial (using ½ mile buffer in all directions from centerline or point)			
	Low Income Population	*Minority Population*	*Aged Population*	*Youth Population*
1	The percentage of the low income population within the half mile buffer is less than the countywide percentage for this population.	The percentage of the minority population within the half mile buffer is less than the countywide percentage for this population.	The percentage of the age 65 or older population within the half mile buffer is less than the countywide percentage for this population.	The percentage of the age 17 or younger population within the half mile buffer is less than the countywide percentage for this population.
0.5	The percentage of the low income population within the half mile buffer is between 100 percent and 149 percent of the countywide percentage for this population.	The percentage of the minority population within the half mile buffer is between 100 percent and 149 percent of the countywide percentage for this population.	The percentage of the age 65 or older population within the half mile buffer is between 100 percent and 149 percent of the countywide percentage for this population.	The percentage of the age 17 or younger population within the half mile buffer is between 100 percent and 149 percent of the countywide percentage for this population.
0	The percentage of the low income population within the half mile buffer is 150 percent or more of the countywide percentage for this population.	The percentage of the minority population within the half mile buffer is 150 percent or more of the countywide percentage for this population.	The percentage of the age 65 or older population within the half mile buffer is 150 percent or more of the countywide percentage for this population.	The percentage of the age 17 or younger population within the half mile buffer is 150 percent or more of the countywide percentage for this population.

SCORE	Connector (using 500' buffer in all directions from centerline or point)			
	Low Income Population	*Minority Population*	*Aged Population*	*Youth Population*
1	The percentage of the low income population within the five hundred foot buffer is less than the countywide percentage for this population.	The percentage of the minority population within the five hundred foot buffer is less than the countywide percentage for this population.	The percentage of the age 65 or older population within the five hundred foot buffer is less than the countywide percentage for this population.	The percentage of the age 17 or younger population within five hundred foot buffer is less than the countywide percentage for this population.
0.5	The percentage of the low income population within the five hundred foot buffer is between 100 percent and 149 percent of the countywide percentage for this population.	The percentage of the minority population within the five hundred foot buffer is between 100 percent and 149 percent of the countywide percentage for this population.	The percentage of the age 65 or older population within the five hundred foot buffer is between 100 percent and 149 percent of the countywide percentage for this population.	The percentage of the age 17 or younger population within the five hundred foot buffer is between 100 percent and 149 percent of the countywide percentage for this population.
0	The percentage of the low income population within the five hundred foot buffer is 150 percent or more of the countywide percentage for this population.	The percentage of the minority population within the five hundred foot buffer is 150 percent or more of the countywide percentage for this population.	The percentage of the age 65 or older population within the five hundred foot buffer is 150 percent or more of the countywide percentage for this population.	The percentage of the age 17 or younger population within the five hundred foot buffer is 150 percent or more of the countywide percentage for this population.

The **Geology Criteria** has a combined score of 4 (maximum) and considers proximity of the project to either sinkholes (up to 1 point), archeological and historical sites (up to 2 points), and hazardous waste sites (up to 1 point). These points are given if the project is not located within a 100 to 500 foot buffer of these sites (depending on the type of roadway). Points are assessed as shown in Table 5.43, Table 5.44, and Table 5.45.

Table 5.43: Sinkhole Scoring (*FLDOT 2008*, p. E-9)

SCORE	**Interstate, Turnpike, or Expressway** (using 500' buffer in all directions from centerline or point)
	Presence of Reported Sinkholes
1	No reported sinkholes within the project area
0.5	One reported sinkhole within the project area
0	More than one reported sinkhole within the project area

SCORE	**Arterial** (using 200' buffer in all directions from centerline or point)
	Presence of Reported Sinkholes
1	No reported sinkholes within the project area
0.5	One reported sinkhole within the project area
0	More than one reported sinkhole within the project area

SCORE	**Connector** (using 100' buffer in all directions from centerline or point)
	Presence of Reported Sinkholes
1	No reported sinkholes within the project area
0.5	One reported sinkhole within the project area
0	More than one reported sinkhole within the project area

Table 5.44: Archeological and Historical Measures and Scores (*FLDOT 2008*, p. E-10:11)

SCORE	Interstate, Turnpike, or Expressway (using 500' buffer in all directions from centerline or point)	
	*Archaeological Sites***	*Built Environment Locations***
2	Absence of any unevaluated, recommended eligible or eligible archaeological sites within the project area.	Project area must contain fewer than two unevaluated, recommended eligible or eligible built environment locations to be rated low.
1	Presence of one to two unevaluated, recommended eligible or eligible archaeological sites within the project area.	Project area must contain fewer than ten unevaluated, recommended eligible or eligible built environment locations.
0	Presence of three or more unevaluated, recommended eligible, or eligible archaeological sites within the project area.	Project area contains ten or more unevaluated, recommended eligible or eligible built environment locations.

SCORE	Arterial (using 200' buffer in all directions from centerline or point)	
	*Archaeological Sites***	*Built Environment Locations***
2	Absence of any unevaluated, recommended eligible or eligible archaeological sites within the project area.	Project area must contain fewer than two unevaluated, recommended eligible or eligible built environment locations to be rated low.
1	Presence of one to two unevaluated, recommended eligible or eligible archaeological sites within the project area.	Project area must contain fewer than ten unevaluated, recommended eligible or eligible built environment locations.
0	Presence of three or more unevaluated, recommended eligible, or eligible archaeological sites within the project area.	Project area contains ten or more unevaluated, recommended eligible or eligible built environment locations.

SCORE	Connector (using 100' buffer in all directions from centerline or point)	
	*Archaeological Sites***	*Built Environment Locations***
2	Absence of any unevaluated, recommended eligible or eligible archaeological sites within the project area.	Project area must contain fewer than two unevaluated, recommended eligible or eligible built environment locations to be rated low.
1	Presence of one to two unevaluated, recommended eligible or eligible archaeological sites within the project area.	Project area must contain fewer than ten unevaluated, recommended eligible or eligible built environment locations.
0	Presence of three or more unevaluated, recommended eligible, or eligible archaeological sites within the project area.	Project area contains ten or more unevaluated, recommended eligible or eligible built environment locations.

Table 5.45: Hazardous Waste/Contamination Scoring (*FLDOT 2008*, p. E-12)

SCORE	Interstate, Turnpike, or Expressway (using 500' buffer in all directions from centerline or point)
	Sum of Points for Identified Sites Within Project Area
1	Sum of Points < 5
0.5	5 <= Sum of Points < 10
0	Sum of Point >= 10

SCORE	Arterial (using 200' buffer in all directions from centerline or point)
	Sum of Points for Identified Sites Within Project Area
1	Sum of Points < 5
0.5	5 <= Sum of Points < 10
0	Sum of Point >= 10

SCORE	Connector (using 100' buffer in all directions from centerline or point)
	Sum of Points for Identified Sites Within Project Area
1	Sum of Points < 5
0.5	5 <= Sum of Points < 10
0	Sum of Point >= 10

The **Habitat Criteria** measures evaluate potential effects to threatened and endangered species, wildlife habitats, conservation and protected lands (not included in other criteria). Up to two points are awarded for each category (Wildlife habitat and Conservation/preservation) as seen in Table 5.46 and Table 5.47. Points are given if the project does not pass through or is not located within a 100 to 500 foot buffer (depending on the type of roadway) of identified wildlife habitat or protected lands. One or two points are given for Arterial and Connectors if less than 25 or less than 10 percent of the project area is within habitat areas.

Table 5.46: Habitat – Wildlife and Habitat (*FLDOT 2008*, p. E-13:14)

SCORE	Interstate, Turnpike, or Expressway (using 500' buffer in all directions from centerline or point)	
	Threatened and Endangered Species	*Strategic Habitat Conservation Area*
2	No occurrence of threatened or endangered species or species of special concern within the project area.	Less than 33 percent of the project area is characterized by FFWCC as a potential Strategic Habitat Conservation Area.
1	Less than 50 percent coverage of project area by threatened or endangered species or species of special concern.	Between 33 percent and 66 percent of the project area is characterized by FFWCC as Strategic Habitat Conservation Areas.
0	50 percent or greater coverage of project area by threatened or endangered species or species of special concern, or project area contains an officially designated Critical Habitat or an exclusion zone.	Over 66 percent of the project area is characterized as Strategic Habitat Conservation Areas by FFWCC.

SCORE	Arterial (using 200' buffer in all directions from centerline or point)	
	Threatened and Endangered Species	*Strategic Habitat Conservation Area*
2	No occurrence of threatened or endangered species or species of special concern within the project area.	Less than 25 percent of the project area is characterized by FFWCC as a potential Strategic Habitat Conservation Area.
1	Less than 50 percent coverage of project area by threatened or endangered species or species of special concern.	Between 25 percent and 50 percent of the project area is characterized by FFWCC as Strategic Habitat Conservation Areas.
0	50 percent or greater coverage of project area by threatened or endangered species or species of special concern, or project area contains an officially designated Critical Habitat or an exclusion zone.	Over 50 percent of the project area is characterized as Strategic Habitat Conservation Areas by FFWCC.

SCORE	Connector (using 100' buffer in all directions from centerline or point)	
	Threatened and Endangered Species	*Strategic Habitat Conservation Area*
2	No occurrence of threatened or endangered species or species of special concern within the project area.	Less than 10 percent of the project area is characterized by FFWCC as a potential Strategic Habitat Conservation Area.
1	Less than 50 percent coverage of project area by threatened or endangered species or species of special concern.	Between 10 percent and 20 percent of the project area is characterized by FFWCC as Strategic Habitat Conservation Areas.
0	50 percent or greater coverage of project area by threatened or endangered species or species of special concern, or project area contains an officially designated Critical Habitat or an exclusion zone.	Over 20 percent of the project area is characterized as Strategic Habitat Conservation Areas by FFWCC.

Table 5.47: Habitat – Conservation and Preservation (*FLDOT 2008*, p. E-16)

SCORE	Interstate, Turnpike, or Expressway (using 500' buffer in all directions from centerline or point)
2	Project area does not pass through or is located within 500 feet of conservation or preservation lands or Section 4(f) resources.
1	Project does not pass through conservation or preservation lands or Section 4(f) resources but is located adjacent to (within 500 feet) of conservation or preservations lands or Section 4(f) resources.
0	Project area involves in a direct taking or bisection of conservation or preservation lands or Section 4(f) resources.

SCORE	Arterial (using 200' buffer in all directions from centerline or point)
2	Project area does not pass through or is located within 500 feet of conservation or preservation lands or Section 4(f) resources.
1	Project does not pass through conservation or preservation lands or Section 4(f) resources but is located adjacent to (within 500 feet) of conservation or preservations lands or Section 4(f) resources.
0	Project area involves in a direct taking or bisection of conservation or preservation lands or Section 4(f) resources.

SCORE	Connector (using 100' buffer in all directions from centerline or point)
2	Project area does not pass through or is located within 500 feet of conservation or preservation lands or Section 4(f) resources.
1	Project does not pass through conservation or preservation lands or Section 4(f) resources but is located adjacent to (within 500 feet) of conservation or preservations lands or Section 4(f) resources.
0	Project area involves in a direct taking or bisection of conservation or preservation lands or Section 4(f) resources.

The **Water Criteria** involve a number of additional factors including protecting the quality and availability of drinking water; the need for wetlands to help prevent flooding; and protecting Florida's aquatic life. Points are given based on a project's distance from sensitive locations or percent of the project that is within the zones identified by the water criteria. The score is based on the project segment that receives the worst score. Water criteria provide for a maximum of 8 points (*FLDOT 2008*, p. 3-17) with the total for a projects calculated using the metrics in Table 5.48, Table 5.49, Table 5.50, Table 5.51 and Table 5.52.

Table 5.48: Water– Floodplains and flood control (*FLDOT 2008*, p. E-18)

SCORE	Interstate, Turnpike, or Expressway (using 500' buffer in all directions from centerline or point)
1	Project area contains less than 30 percent FEMA designated Special Flood Hazard Area (SFHA) zones and no designated floodways.
0.5	Project area contains between 30 percent and 70 percent FEMA designated SFHA zones or Project area contains a FEMA designated floodway (FW).
0	More than 70 percent of the project area is within a FEMA designated SFHA floodplain zone.

SCORE	Arterial (using 200' buffer in all directions from centerline or point)
1	Project area contains less than 25 percent FEMA designated Special Flood Hazard Area (SFHA) zones and no designated floodways.
0.5	Project area contains between 25 percent and 50 percent FEMA designated SFHA zones or Project area contains a FEMA designated floodway (FW).
0	More than 50 percent of the project area is within a FEMA designated SFHA floodplain zone.

SCORE	Connector (using 100' buffer in all directions from centerline or point)
1	Project area contains less than 10 percent FEMA designated Special Flood Hazard Area (SFHA) zones and no designated floodways.
0.5	Project area contains between 10 percent and 20 percent FEMA designated SFHA zones or Project area contains a FEMA designated floodway (FW).
0	More than 20 percent of the project area is within a FEMA designated SFHA floodplain zone.

Table 5.49: Water– Coastal and marine measure (*FLDOT 2008*, p. E-19)

SCORE	Interstate, Turnpike, or Expressway (using 500' buffer in all directions from centerline or point)
1.75	Project area is not located within 500 feet of a NOAA coastline, National Marine Sanctuaries, seagrass, sensitive shoreline or navigable waterway.
1	Project area is located within 500 feet of a NOAA coastline, National Marine Sanctuaries, seagrass, sensitive shoreline or navigable waterway.
0	Project area is within NOAA coastline, National Marine Sanctuaries, seagrass, sensitive shoreline or navigable waterway.

SCORE	Arterial (using 200' buffer in all directions from centerline or point)
1.75	Project area is not located within 500 feet of a NOAA coastline, National Marine Sanctuaries, seagrass, sensitive shoreline or navigable waterway.
1	Project area is located within 500 feet of a NOAA coastline, National Marine Sanctuaries, seagrass, sensitive shoreline or navigable waterway.
0	Project area is within NOAA coastline, National Marine Sanctuaries, seagrass, sensitive shoreline or navigable waterway.

SCORE	Connector (using 100' buffer in all directions from centerline or point)
1.75	Project area is not located within 500 feet of a NOAA coastline, National Marine Sanctuaries, seagrass, sensitive shoreline or navigable waterway.
1	Project area is located within 500 feet of a NOAA coastline, National Marine Sanctuaries, seagrass, sensitive shoreline or navigable waterway.
0	Project area is within NOAA coastline, National Marine Sanctuaries, seagrass, sensitive shoreline or navigable waterway.

Table 5.50: Water– Special designations (*FLDOT 2008*, p. E-20:21)

SCORE	Interstate, Turnpike, or Expressway (using 500' buffer in all directions from centerline or point)	
	Aquatic Preserves and Outstanding Florida Waters	*Coastal Barrier Island Resources*
1.75	Project area: does not cross watersheds of any aquatic preserves or Outstanding Florida Waters, does not cross any major tributaries of Outstanding Florida Waters, and is not within 0.5 miles of any aquatic preserve or Outstanding Florida Waters.	Project area is not within 500 feet of a designated CBRA coastal barrier unit.
1	Project area: contains a portion of an aquatic preserve or Outstanding Florida Waters, but does not cross it or is within 0.5 miles of aquatic preserve boundary or Outstanding Florida Waters.	Project area: is partially within a designated CBRA coastal barrier unit, or is within 500 feet of a designated CBRA coastal barrier unit.
0	Project area crosses at least 1 designated or proposed portion of aquatic preserve or Outstanding Florida Waters.	Project area is completely within a designated CBRA coastal barrier unit.

SCORE	Arterial (using 200' buffer in all directions from centerline or point)	
	Aquatic Preserves and Outstanding Florida Waters	*Coastal Barrier Island Resources*
1.75	Project area: does not cross watersheds of any aquatic preserves or Outstanding Florida Waters, does not cross any major tributaries of Outstanding Florida Waters, and is not within 0.5 miles of any aquatic preserve or Outstanding Florida Waters.	Project area is not within 500 feet of a designated CBRA coastal barrier unit.
1	Project area: contains a portion of an aquatic preserve or Outstanding Florida Waters, but does not cross it or is within 0.5 miles of aquatic preserve boundary or Outstanding Florida Waters.	Project area: is partially within a designated CBRA coastal barrier unit, or is within 500 feet of a designated CBRA coastal barrier unit.
0	Project area crosses at least 1 designated or proposed portion of aquatic preserve or Outstanding Florida Waters.	Project area is completely within a designated CBRA coastal barrier unit.

SCORE	Connector (using 100' buffer in all directions from centerline or point)	
	Aquatic Preserves and Outstanding Florida Waters	*Coastal Barrier Island Resources*
1.75	Project area: does not cross watersheds of any aquatic preserves or Outstanding Florida Waters, does not cross any major tributaries of Outstanding Florida Waters, and is not within 0.5 miles of any aquatic preserve or Outstanding Florida Waters.	Project area is not within 500 feet of a designated CBRA coastal barrier unit.
1	Project area: contains a portion of an aquatic preserve or Outstanding Florida Waters, but does not cross it or is within 0.5 miles of aquatic preserve boundary or Outstanding Florida Waters.	Project area: is partially within a designated CBRA coastal barrier unit, or is within 500 feet of a designated CBRA coastal barrier unit.
0	Project area crosses at least 1 designated or proposed portion of aquatic preserve or Outstanding Florida Waters.	Project area is completely within a designated CBRA coastal barrier unit.

Table 5.51: Water- Water Quality (*FLDOT 2008*, p. E-22)

SCORE	Interstate, Turnpike, or Expressway (no buffer)	
	Surface Water – Resources	*Ground Water – Wells*
1.75	Project alignment is not within 0.5 mile of an aquatic preserve, Outstanding Florida Waters, Class I or Class II water.	No more than two public water supply wells have been identified within, or within 500 feet of the project alignment.
1	Project alignment is within 0.5 mile and in the watershed of an aquatic preserve or Outstanding Florida Waters, but does not cross it, or is within 0.5 mile of a Class I or Class II water.	Project alignment contains, or has within 500 ft of its borders, between three and five public water supply wells from the above data set.
0	Project alignment crosses at least one designated or proposed portion of aquatic preserve, Outstanding Florida Waters, Class I or Class II waters.	Project alignment contains, or has within 500 ft of its borders, six or more public water supply wells from the above data set.

SCORE	Arterial (no buffer)	
	Surface Water – Resources	*Ground Water – Wells*
1.75	Project alignment is not within 0.5 mile of an aquatic preserve, Outstanding Florida Waters, Class I or Class II water.	No more than two public water supply wells have been identified within, or within 500 feet of the project alignment.
1	Project alignment is within 0.5 mile and in the watershed of an aquatic preserve or Outstanding Florida waters, but does not cross it, or is within 0.5 mile of a Class I or Class II water.	Project alignment contains, or has within 500 ft of its borders, between three and five public water supply wells from the above data set.
0	Project alignment crosses at least one designated or proposed portion of aquatic preserve, Outstanding Florida Waters, Class I or Class II waters.	Project alignment contains, or has within 500 ft of its borders, six or more public water supply wells from the above data set.

SCORE	Connector (no buffer)	
	Surface Water – Resources	*Ground Water – Wells*
1.75	Project alignment is not within 0.5 mile of an aquatic preserve, Outstanding Florida Waters, Class I or Class II water.	No more than two public water supply wells have been identified within, or within 500 feet of the project alignment.
1	Project alignment is within 0.5 mile and in the watershed of an aquatic preserve or Outstanding Florida Waters, but does not cross it, or is within 0.5 mile of a Class I or Class II water.	Project alignment contains, or has within 500 ft of its borders, between three and five public water supply wells from the above data set.
0	Project alignment crosses at least one designated or proposed portion of aquatic preserve, Outstanding Florida Waters, Class I or Class II waters.	Project alignment contains, or has within 500 ft of its borders, six or more public water supply wells from the above data set.

Table 5.52: Water- Wetlands (*FLDOT 2008*, p. E-24:25)

SCORE	Interstate, Turnpike, or Expressway (using 500' buffer in all directions from centerline or point)			
	Wetlands	*Forested Wetlands*	*Mangrove forest or salt marsh*	*Wetland crossing*
1.75	Less than 33 percent of the project area is composed of wetlands.	Less than 20 percent of the project area is composed of forested wetlands.	There are no wetlands that are estuarine in type (mangrove forest or salt marsh).	No wetlands extend across the entire project area such that a single wetland crossing of greater than 5 percent of the length of the project area would be required regardless of right of way alignment within the project area.
1	Between 33 percent and 66 percent of the project area is composed of wetlands.	Between 20 percent and 40 percent of the project area is composed of forested wetlands.	Wetlands that are estuarine in type (mangrove forest or salt marsh) are present in less than 20 percent of the project area.	Wetlands extend across the entire project area such that a single wetland crossing of 5-10 percent of the project area would be required regardless of right of way alignment.
0	Over 66 percent of the project area is composed of wetlands.	Over 40 percent of the project area is composed of forested wetlands.	Wetlands that are estuarine in type (mangrove forest or salt marsh) comprise over 20 percent of the project area.	Wetlands extend across the entire project area such that a single wetland crossing of greater than 10 percent of the project area would be required regardless of right of way alignment.

SCORE	Arterial (using 200' buffer in all directions from centerline or point)			
	Wetlands	*Forested Wetlands*	*Mangrove forest or salt marsh*	*Wetland crossing*
1.75	Less than 25 percent of the project area is composed of wetlands.	Less than 10 percent of the project area is composed of forested wetlands.	There are no wetlands that are estuarine in type (mangrove forest or salt marsh).	No wetlands extend across the entire project area such that a single wetland crossing of greater than 5 percent of the length of the project area would be required regardless of right of way alignment within the project area.
1	Between 25 percent and 50 percent of the project area is composed of wetlands.	Between 10 percent and 20 percent of the project area is composed of forested wetlands.	Wetlands that are estuarine in type (mangrove forest or salt marsh) are present in less than 10 percent of the project area.	Wetlands extend across the entire project area such that a single wetland crossing of 5-10 percent of the project area would be required regardless of right of way alignment.
0	Over 50 percent of the project area is composed of wetlands.	Over 20 percent of the project area is composed of forested wetlands.	Wetlands that are estuarine in type (mangrove forest or salt marsh) comprise over 10 percent of the project area.	Wetlands extend across the entire project area such that a single wetland crossing of greater than 10 percent of the project area would be required regardless of right of way alignment.

SCORE	Connector (using 100' buffer in all directions from centerline or point)			
	Wetlands	*Forested Wetlands*	*Mangrove forest or salt marsh*	*Wetland crossing*
1.75	Less than 10 percent of the project area is composed of wetlands.	Less than 5 percent of the project area is composed of forested wetlands.	There are no wetlands that are estuarine in type (mangrove forest or salt marsh).	No wetlands extend across the entire project area such that a single wetland crossing of greater than 5 percent of the length of the project area would be required regardless of right of way alignment within the project area.
1	Between 10 percent and 20 percent of the project area is composed of wetlands.	Between 5 percent and 10 percent of the project area is composed of forested wetlands.	Wetlands that are estuarine in type (mangrove forest or salt marsh) are present in less than 5 percent of the project area.	Wetlands extend across the entire project area such that a single wetland crossing of 5-10 percent of the project area would be required regardless of right of way alignment.
0	Over 20 percent of the project area is composed of wetlands.	Over 10 percent of the project area is composed of forested wetlands.	Wetlands that are estuarine in type (mangrove forest or salt marsh) comprise over 5 percent of the project area.	Wetlands extend across the entire project area such that a single wetland crossing of greater than 10 percent of the project area would be required regardless of right of way alignment.

5.1.2.2 Rail

Table 5.53 provides a list of performance measures the Florida DOT chose as ideal measures with which to gauge how the DOT goals are being met for rail investments.

Table 5.53: Ideal Performance measures (*FLDOT 2010b*, p. 5-4)

Goal	Performance Measures
Safety and Security	• Crash reduction from auto/truck diversion • Reduced exposure to grade crossings • Use of Intelligent Transportation Management technologies
Quality of Life and Environmental Stewardship	• Change in auto/truck fuel consumption and CO_2 emissions • Noise reduction • Status of environmental screening process • Project included in land use plans, State Transportation Plan, LRTP, or County/Municipal Improvement Plan
Maintenance and Preservation	• Train capacity increase • Consistent with asset management approach • Support modernized rail system management and operation technologies
Mobility and Economic Competitiveness	• Auto/Truck VMT reduction • Reduced travel time and vehicle operating costs • Increase in passenger rail ridership • Increase in freight ton-miles • GDP growth • Jobs created as a result of the project
Sustainable Investments	• Project underwent public review • Support from stakeholders • Status of application for funding • Eligible for state or Federal funding • Non-Federal state/Federal funding available and programmed for project • Supports underserved areas • Project of Statewide significance

Source: Cambridge Systematics.

Before prioritization, the rail needs identified by the reporting agency were given a score of High (H), Medium (M), or Low (L) on each of the above measures to arrive at a list of prioritized projects. For assistance in this ranking, the FLDOT developed measures for each of these criteria as shown in Table 5.54 (Table B.1 from *FLDOT 2010b*).

Table 5.54: Florida System Plan Performance Measures

Goal Area	Indicator	Units	Calculate for Project Type? (Y/N)			Notes
			Pass.	Grade Cross	Frt.	
Safety and Security	Crash Reduction from Auto/ Truck Diversion	$	Y	N	Y	Auto diversion for passenger, trucks for freight, not calculated for quiet zones
	Reduced Exposure to Grade Crossings	minutes	N	Y	N	
	Use of Intelligent Transportation Management Technologies	Yes/No	Y	Y	Y	Not calculated for qu zones
Quality of Life and Environmental Stewardship	Change in Auto/Truck Fuel Consumption	Gallons of Fuel	Y	N	Y	Not calculated for qu zones
	Change in Auto/Truck $C0_2$	Tons of CO_2	Y	N	Y	Not calculated for qu zones
	Encourages Noise Reduction	Yes/No	N	N	Y	Relevant for freight quiet zones only
	Status of Environmental Screening Process	Categorical	Y	Y	Y	
	Project Included in Land-use Plans	Yes/No	Y	Y	Y	
	Project Included in State Transportation Plan	Yes/No	Y	Y	Y	
	Project Included in LRTP	Yes/No	Y	Y	Y	
	Project Included in County/ Municipal Improvement Plan	Yes/No	Y	Y	Y	
Maintenance and Preservation	Train Capacity Increase	Percent	N	N	Y	Calculated for rehab, 286,000 upgrade, accessibility only
	Consistent with Asset Management Approach	Yes/No	Y	Y	Y	Calculated for work o existing assets only
	Support Modernized Rail System Management and Operation Technologies	Yes/No	Y	Y	Y	

Goal Area	Indicator	Units	Calculate for Project Type? (Y/N)			Notes
			Pass.	Grade Cross	Frt.	
Mobility and Economic Competitiveness	Auto VMT Reduction	VMT	Y	N	Y	Not calculated for quiet zones
	Truck VMT Reduction	VMT	Y	N	Y	Not calculated for quiet zones
	Reduced Travel Time Cost	$	Y	N	Y	Not calculated for quiet zones
	Reduced Vehicle Operating Cost	$	Y	N	Y	Not calculated for quiet zones
	Increase in Passenger Rail Ridership	Passengers	Y	N	N	Specified by project nominee
	Increase in Freight Ton-Miles	Net Ton-Miles	N	Y	Y	Specified by project nominee
	GDP Growth	$	Y	Y	Y	
	Jobs Created as a Result of the Project	Total Number of Jobs	Y	Y	Y	Specified by project nominee
Sustainable Investment	Project Underwent Public Review	Yes/No	Y	Y	Y	
	Support from Stakeholders	Categorical	Y	Y	Y	
	Status of Application for Funding	Categorical	Y	Y	Y	
	Eligible for Federal Funding	Yes/No	Y	Y	Y	
	Eligible for State Funding	Yes/No	Y	Y	Y	
	Non-Federal State/Federal Funding Available and Programmed for Project	Yes/No	Y	Y	Y	
	Supports Underserved Areas	Yes/No	Y	Y	Y	
	Project of Statewide Significance	Yes/No	Y	Y	Y	

Some of the measures are calculated just for passenger projects or just for freight projects. While actual calculations are made for some of these factors, others are simply categorical ("Yes" or "No"). A methodology for calculations are provided for:

- VMT reduction in Truck Traffic
- Crash Reduction from Auto/Truck Diversion
- Change in Fuel Consumption
- Change in CO2 Emissions
- Train Capacity Increase
- Travel Time Savings for Freight
- Reduced Vehicle operating cost for freight

VMT reduction in Truck Traffic: For freight projects the VMT reduction in truck traffic (TRUCKVMTD) is calculated as:

TRUCKVMTD = (TRAINTONMILESAFTER-
TRAINTONMILESBEFORE)/AVERAGETONSPERTRUCK

Where AVERAGETONSPERTRUCK is assumed to be 20, and truck trip lengths are assumed to be the same as train trip lengths.

Crash Reduction from Truck Diversion: The value of crash reduction from a freight rail investment is calculated by multiplying the VMT reduction above (TRUCKVMTD) by the unit crash cost per 1000 VMT calucalted by HERS for FLDOT. The unit crash cost is estimated to be $157 per 1000 VMT.

Change in Fuel Consumption: The change in fuel consumption (AVFUELSAVING) is again based on the above reduction in truck VMT (TRUCKVMTD). It is calculated as:

AVFUELSAVING= TRUCKVMTD/MPGTRUCK

Where MPGTRUCK is the average miles per gallon for trucks in Florida as estimated by the EPA. There is no accounting for the increase in fuel consumption by trains.

Change in CO2 Emissions: The change in CO2 emissions is calculated using the estimated change in fuel consumption (above). This is calculated using the EPA's estimate of 8788 grams of CO2 per gallon of gasoline (CO2PG).

COChange =AVFUELSAVING*CO2PG

Train Capacity Increase: Train capacity increase is assumed to be 10% for 286K upgrades and 65% for doublestack improvements.

Travel Time Savings for Freight: The value of truck time (TTCOSTTRUCK) includes both the value of driver time and inventory cost of $690 per 1000 VMT as estimated from previous FLDOT studies. The value of rail inventory cost (VOTRAINFREIGHT) of $0.39 per ton-hour as estimated from their previous studies. The value of travel time savings for freight (ABENFREIGHTTT) is calculated as:

ABENFREIGHTTT =1000*TRAINTONMILESBEFORE
/AVTRUCKTRIPLEN* (TRAINTIMEBEFORE-TRAINTIMEAFTER)*
VOTRAINFREIGHT+ (TRAINTONMILESAFTER-
TRAINTONMILESBEFORE)* TTCOSTTRUCK/ AVTONSPERTRUCK-
1000* (TRAINTONMILESAFTER- TRAINTONMILESBEORE)/
AVTRUCKTRIPLEN* TRINTIMEAFTER* VOTTRAINFREIGHT

Reduced Vehicle Operating Cost for Freight: This is calculated using the cost savings from the diversion of truck traffic to rail (ABENFTRUCKOP) and is partially offset by the increase in rail costs.

ABENFTRUCKOP= TRUCKVMTD*OPCOSTTRUCK-
1000(TRAINMILESAFTER-TRAINMILESBEFORE)*OCFREIGHT

Where OPCOSTTRUCK is the operating cost per 1000 truck VMT as estimated previously by FLDOT to be $1161 and OCFREIGHT is the $0.046 per ton-mile of rail freight estimate using the waybill sample.

Finally, despite these efforts at measurement and ranking, the FLDOT rail prioritization ultimately uses the following Table 5.55 and High, Medium, and Low ratings to come up with the prioritization list for rail projects. This practical list of ranked criteria differs considerably from the ideal list in Table 5.53 above.

Table 5.55: Practical Scoring Criteria (*FLDOT 2010b*, p. 5-24:25)

Criteria	Ranking (Score)	Definition
Funding Status	High (3)	Project is currently funded or partially funded.
	Medium (2)	Project is not currently funded, but is eligible for funding from one or more sources.
	Low (1)	Project is not currently funded and no potential/eligible funding sources have been identified.
Coordination Status	High (3)	Project has consulted with multiple plans (e.g., Florida Transportation Plan, local comprehensive plans), agencies, and stakeholders; and has received public support.
	Medium (2)	Project has consulted with one or more plans or agencies and/or has received some public support.
	Low (1)	No evidence of coordination with other plans and/or agencies and no evidence of public support.
State and/or Regional Significance	High (3)	Project is of statewide significance.
	Medium (2)	Project is of regional significance.
	Low (1)	Project is not of statewide or regional significance.
Environmental Review Status *(criteria considered only as a component of shovel readiness)*	High (3)	All environmental review for the project has been completed, or environmental review is not necessary.
	Medium (2)	Required environmental review for the project is currently underway.
	Low (1)	Environmental review of the project has not yet been undertaken or information about the environmental review status of the project is not available.

5.1.2.3 Summary/Analysis

While the Florida scorecard for prioritization of freight projects for highway and rail have similar guiding Criteria or goals, the implementation of these scorecards is quite different. No effort is made in these rating schemes to allow for comparison of investment projects across modes.

The highway scorecard provides very detailed guidance for scoring each criteria and subcriteria, and have well-developed measures, leaving little to subjective evaluation. The implementation of the rail approach has much less detail and no instructions as to how to score the various measures (when available). Indeed, many of the rail criteria are categorical (yes or no) without an indication of the degree to which the criteria is fulfilled.

The rail guidelines provide the most detail in the calculation for the potential diversion of truck traffic from highways to rail. As noted above, the basic assumption---that any increase in rail traffic comes from diversion of truck traffic---is an extreme case that will result in the largest possible benefits to rail investment. Further inflating the calculation of the beneficial aspects from rail is the assumption that average trip lengths for truck and rail are equal---truck trip lengths are known to be shorter on average. Also, the recommended rail methodology is to use their estimate of truck VMT diversion to obtain estimates for fuel savings and emissions reduction---which as a result will also be upward biased.

The highway scorecard does not have any measure for emissions.

5.1.3 Maryland Scorecard Evaluation

Maryland's prioritization of freight projects recognizes many projects that impact freight may also benefit a wider group of stakeholders, not just those involved directly with freight transport. A freight project is defined as follows:

> "A freight project is a planned improvement to the Maryland transportation system that sustains movement and supports the state's economic competitiveness. The project may provide improved operations, expansion, or new capacity. It is distinguished from other transportation projects because it provides improved service or capacity to one of the freight modes (highway, rail, water, air) on a transportation facility that significantly supports the local, regional, state, or national economy." (*MdDOT 2009*, p. 8-1)

Although the focus of their prioritization process is on freight, other factors are considered especially in the areas of Safety, Security, and Quality of Service. The five criteria used in the prioritization process are shown in Table 5.56 along with the weights assigned to each criterion.

Table 5.56: Evaluation Criteria for Freight Projects (*MdDOT 2010*, p. 8-3)

Criteria	Weighting	Description
Quality of Service	30 %	Potential for the project to reduce delay and increase reliability
Safety and Security	25 %	Potential for the project to provide a safer operating environment and reduce opportunities to compromise the supply chain
Environmental Stewardship/Development Plan Goals	10 %	Potential for the project to reinforce the development of freight-related land uses within existing freight activity centers or direct new development to PFAs and sites with adequate infrastructure
Connectivity for Freight Mobility	25 %	Potential for the project to enhance connectivity between freight modes and/or improve access to clusters of freight-intensive industries
Coordination	10 %	Potential for the project to fulfill the plans, programs or goals of multiple agencies

Below is a review of the freight project prioritization metrics used by Maryland's DOT for Highway and Rail modes. According to the Maryland Statewide Freight Plan, marine projects are presented with the same scorecard approach, but the projects are scored using the professional judgment of Maryland Port Administration Officials (p. 8-6).

The metrics are used to assign a High, Medium or Low rating to each characteristic along with points High (5), Medium (3), and Low (1). A weighted average of the points is taken to arrive at an overall ranking of High, Low, or Medium for the project.

5.1.3.1 Highway

1. Quality of Service (30%)

Quality of service is defined as an equally weighed combination of Average Annual Daily Truck Traffic (ADTT), the truck percentage, the volume to capacity ratio (v/c) and the future v/c ratio. Each of these four categories are sorted in descending order for all projects with the top third receiving a High (5.0), the middle third a Medium (3.0) and the bottom third receiving a Low (1.0). Where data are not available, a Medium (3 point) ranking is given (*MdDOT 2009*, p. 8-4).

2. Safety and Security (25%)

Safety is measured by the crash rate, defined as the average yearly truck rate per mile. These count for 90% of the Safety and Security score. High, Medium, and Low point values (5, 3, and 1) are assigned to each project using the same sorting system described above for Quality of Service. The Security portion is given a rating of High (5 points) if the project includes the development of a truck inspection/weigh station, or given a Low

(1 point) if it does not. 10% of the Safety and Security score is determined from this component. (*MdDOT 2009*, p. 8-4).

3. Environmental Stewardship/Development Plan Goals (10%)

The Environmental Stewardship/Development Plan Criteria rating for highway is based on whether the project is entirely within a Priority Funding Area (PFA) or connects two PFAs. If a project is entirely within a PFA, it is scored High (5.0); if it is not entirely within a PFA but connects two PFAs, it is scored Medium (3.0); and if it is neither in a PFA nor connects PFAs, it is scored Low (1.0) (*MdDOT 2010*, p. 8-4).

There are no metrics specifically for environmental impact or emissions.

4. Connectivity for Freight Mobility (25%)

The Connectivity for Freight Mobility rating is based on whether the project is within or connects to a freight cluster either within Maryland or within 20 miles of Maryland's border. Clusters of freight intensive industries were mapped using Census Bureau employment data, and nine areas were identified where there was a concentration of freight-related employment. If a project was within or connected to one of the nine freight clusters listed, it was given a High score (5 points); if it did not lie within or connect to one of the freight clusters, it was scored Low (1 point) (*MdDOT 2009*, p. 8-4-8-5.)

5. Coordination (10%)

The Coordination rating is based on the extent to which the project is identified in three identified types of agency plans: Local plans, Mid-Atlantic Truck Operations (MAPOs) (does the project address a bottleneck identified in those plans), and Priority Letters (projects listed in the County's Priority Letter to the Secretary of Transportation). In this case, there are four ratings: High (5 points) is assigned if a project is identified in all three types of plans; Medium (3.7 points) is assigned if it is identified in two types of plans; if it is identified in one type of plan it is still given a Medium rating, but fewer points (2.3 points); and it is scored Low (1.0) if it appears in none of the three identified plan types. (*MdDOT 2009*, p. 8-4-8-5)

5.1.3.2 Rail

1. Quality of Service (30%)

The Quality of Service rating is average of ratings for the current Level of Service (LOS) and the future LOS indicators. A project is scored High (5.0) if it is on a section with a LOS of E or F, Medium (3.0) if it is on a section with a LOS of D, and Low (1.0) if it is on a section with a LOS of A, B, or C. (*MdDOT 2009*, p. 8-5)

2. Safety and Security (25%)

A score of 3 was the lowest given any rail project and that was only if the project was determined to have no counterpart in other specified initiatives such as the MAPOs, the Crescent Corridor, or National Gateway initiatives. Almost all rail projects were given a High (5 point) Safety and Security rating under the assumption that rail is safer and more secure than truck. (*MdDOT 2009*, p. 8-5)

3. Environmental Stewardship/Development Plan Goals (10%)

Rail projects were again given a High (5 point) rating under the assumption that they were more fuel efficient and environmentally friendly than rail. The exception was again for the same projects that were found to have no counterpart in other initiatives identified for Safety and Security, in which case they were given 3 points. (*MdDOT 2009*, p. 8-5)

4. Connectivity for Freight Mobility (25%)

A High (5.0) rating is given to projects that are part of the Crescent Corridor, National Gateway, or MARC Growth and Investment Plan Initiatives. In this case it is not clear whether any rating other than 5 is given for projects that are not part of these initiatives. (*MdDOT 2009*, p. 8-5)

5. Coordination (10%)

A High (5.0) rating is given to projects that are part of the MAROs, Crescent Corridor, National Gateway, or MARC Growth and Investment Plan Initiatives (*MdDOT 2009*, p. 8-6).

As an example of the final scorecard presentation, Table 5.57 provides final scorecards for three projects. Each of the goals is given a qualitative score of High (dark circle), Medium (half circle), and Low (empty circle) based on the performance metrics. A complete list of prioritized 2009 projects is provided in Maryland DOT (*2009*, p. 8-7 to 8-12).

Table 5.57: Scorecard Example (*MdDOT 2010*, p. 8-7).

Name of Project	Jurisdiction	Overall Score	Quality of Service (30 %)	Safety and Security (25 %)	Environmental Stewardship/ Development Plan Goals (10%)	Connectivity for Freight Mobility (25%)	Coordination (10%)
Interstate 81 Reconstruct and widen- WV Line to PA Line	Washington County	●	●	◑	●	●	◑
Interstate 70 Reconstruct and widen – I -81 to Frederick County Line	Washington County	●	●	◑	◑	●	◑
Interstate 70 Reconstruct and widen – Washington County Line to west of Mt. Phillip Road	Frederick County	●	●	◑	○	●	◑

5.1.3.3 Summary/Analysis

Although this scorecard uses the same criteria for all freight modes, metrics are not always directly comparable across modes.

While the highway mode uses ADTT, percent of truck traffic, and v/c and future v/c ratios, the rail defines Quality of Service in terms of LOS categories. Although these give an idea of vehicle flows, they do not necessarily give comparable measures of the volume of freight going by the different modes as would be found if a measure such as TEU equivalents were used.

In the case of Safety and Security, the Highway mode uses crash rates, truck crash rates in particular, as part of the Safety component. They also focus on inspection stations for Security. Both of these metrics are closely related to what is generally accepted as Safety and Security. For rail, however, there are no such metrics. Rather, rail is simply assumed to be safer and more secure than highway, and thus almost always received full scores for these criteria. Metrics such as crashes/fatalities at rail crossings, derailments, etc. would be able to provide a comparable metric across these modes.

The measures used for Environmental Stewardship/Development Plan Goals for highway projects do not consider any environmental impacts of emissions. Rather, the scoring is based solely of whether the project is in or links Priority Funding Areas (PFAs) which effectively concentrates on the economic development part of this criterion, but not the environmental portion. Interestingly enough, for rail there is no explicit measure but rather the assumption that rail uses less fuel and thus is more environmentally friendly---and most rail projects get full points for this. Thus, highway projects are rated based on economic development criteria while rail are rated on environmental criteria---not only are the metrics used totally different (or non-existent), but the interpretation of the criteria is totally different from these two modes. Neither one has any real metric for environmental stewardship (or emissions) nor does highway even acknowledge the environmental part of this criterion.

5.1.4 Missouri Scorecard Evaluation

The Missouri Long Range Transportation Plan (LRTP) was created and is maintained with input from the state DOT, metropolitan planning offices (MPOs), Regional Planning Commissions (RPCs). It encourages public input before final decisions are made. Potential projects are submitted by the state DOT, an MPO, an RPC, a citizen or a company. In order to determine which projects receive funding, the LRTP has developed a qualitative ranking process. Below is an overview of this detailed process.

This evaluation has been developed specifically for highway projects but could be used for other modes (water projects in Missouri have considered using this methodology) with the development of appropriate mode-specific performance measures.

5.1.4.1 Project Types

Six types of projects have been determined, two as systematic and functional need-based projects, and the other four as categorical improvement projects.

- Needs Prioritization: two kinds of basic needs for the allocation of MoDOT funds
    - Physical System Conditional Needs: These needs are directed at the maintenance of existing pavements and bridges throughout the transportation system
    - Functional Needs: These needs are defined as those that improve an operational aspect of the transportation system.
    - Project Prioritization: besides the two kinds of projects classified as transportation system needs, other proposed projects fall into one of the following four categories.
    - Safety
    - Taking Care of the System
    - Major Projects: System Expansion
    - Regional and Emerging Needs Projects

While all projects are evaluated using the same general criteria discussed in the following section, the weights and points assigned to sub-criteria differ according to project type.

5.1.4.2 Project Criteria and Performance Measures

Each of the project types incorporate the same underlying eight criteria for ranking, but the final objective value for each project depends on the type-specific weight assigned to each criteria. The eight universal criteria are:

- Access to Opportunity
- Congestion Relief
- Economic Competitiveness
- Efficient Movement of Freight
- Quality of Communities
- Environmental Protection
- Safety
- Taking Care of the System

These projects are general highway projects affecting both passenger and freight movements. The only part of the scorecard that specifically relates to freight are the factors listed under the Criterion: Efficient Freight Movement. The Efficient Movement of Freight (or goods) criterion carries no weight in projects dealing with Physical System Needs and Safety projects. For major System Expansion projects only a 5% weight is given to Efficient Movement of Freight. In the remaining categories of projects the weight assigned to Efficient Freight Movement varies over a range, specified as 5-30% for Functional Needs and Regional and Emerging Needs, 0-20% for Taking Care of the System Needs.

The scorecards used for each of the project types are shown in the following Table 5.58, Table 5.59, Table 5.60, Table 5.61, Table 5.62, and Table 5.63 (reproduced from APPENDIX A – Scorecard Approaches for Prioritization Processes, (*MoDOT 2004*, p. 39-45).

Table 5.58: Functional Needs

Functional Needs

Prioritization Process

Functional Needs
11/04/2003

This process does not apply in TMA areas

Access to Opportunity	
Weight: 5% minimum - 30% maximum	
Vehicle Ownership	50 pts
District Factors/Flexible Points	50 pts
Total	**100 pts**

Congestion Relief	
Weight: 5% minimum - 30% maximum	
Level of Service	25 pts
Daily Usage	25 pts
Functional Classification	25 pts
District Factors/Flexible Points	25 pts
Total	**100 pts**

Economic Competitiveness	
Weight: 5% minimum - 30% maximum	
Level of Economic Distress	30 pts
Supports Regional Economic Development Plans	20 pts
District Factors/Flexible Points	50 pts
Total	**100 pts**

Efficient Movement of Freight	
Weight: 5% minimum - 30% maximum	
Truck Volume	50 pts
Freight Bottlenecks	20 pts
Intermodal Freight Connectivity	10 pts
District Factors/Flexible Points	20 pts
Total	**100 pts**

Quality of Communities	
Weight: 5% minimum - 30% maximum	
Connectivity	40 pts
Complies with Regional or Local Transportation Plans	30 pts
District Factors/Flexible Points	30 pts
Total	**100 pts**

Environmental Protection	
Weight: 0% minimum - 30% maximum	
District Factors/Flexible Points	100 pts

Safety	
Weight: 20% minimum - 50% maximum	
Safety Index	85 pts
Safety Concern	5 pts
District Factors/Flexible Points	10 pts
Total	**100 pts**

Taking Care of the System	
Weight: 5% minimum - 30% maximum	
Substandard Roadway Features **OR** Substandard Bridge Features	75 pts
District Factors/Flexible Points	25 pts
Total	**100 pts**

- **The glossary explains how each factor is scored.**
- **MoDOT Districts will allocate 50% of the weight among investment goals.**
- **"District Factors/Flexible Points" may be used to capture unique items that are important to an individual region or can be allocated among existing factors.**
- **The weight of investment goals must meet minimum and maximum percentages noted above. The total weight of all investment goals must equal 100%.**
- **MPOs designated as Transportation Management Areas may develop their own functional needs prioritization process, subject to certification by MoDOT.**

Table 5.59: Physical System Condition Needs

Physical System Condition Needs

Physical System Condition Needs
11/04/2003

This process applies to all areas of the state

Taking Care of the System

Roadway	
Pavement Smoothness	30 pts
Pavement Condition	20 pts
Functional Classification	10 pts
Daily Usage (all vehicles)	10 pts
Truck Usage	10 pts
District Factors/Flexible Points	20 pts
Total	**100 pts**
- OR -	
Bridge	
Bridge Condition	50 pts
Functional Classification	10 pts
Daily Usage (all vehicles)	10 pts
Truck Usage	10 pts
District Factors/Flexible Points	20 pts
Total	**100 pts**

- The glossary explains how each factor is scored.
- There is no flexibility among investment goals in this prioritization process because the other goals do not have a direct effect on measuring the physical system condition needs on the transportation system.
- The flexibility lies in "district factors/flexible points," which can be used to capture unique items that are important to an individual region or can be allocated among existing factors.

Table 5.60: Taking Care of the System Projects

Prioritization Process

Taking Care of the System
11/04/2003

Taking Care of the System Projects

This process applies to all areas of the state

Access to Opportunity
Weight: 0% minimum - 20% maximum

Eliminate Bike/Ped Barriers (ADA)	25 pts
Vehicle Ownership	25 pts
District Factors/Flexible Points	50 pts
Total	**100 pts**

Congestion Relief
Weight: 0% minimum - 20% maximum

Level of Service	75 pts
District Factors/Flexible Points	25 pts
Total	**100 pts**

Economic Competitiveness
Weight: 0% minimum - 20% maximum

Strategic Economic Corridor	30 pts
Level of Economic Distress	20 pts
District Factors/Flexible Points	50 pts
Total	**100 pts**

Efficient Movement of Freight
Weight: 0% minimum - 20% maximum

Truck Volume	90 pts
District Factors/Flexible Points	10 pts
Total	**100 pts**

Quality of Communities
Weight: 0% minimum - 20% maximum

District Factors/Flexible Points	100 pts
Total	**100 pts**

Environmental Protection
Weight: 0% minimum - 20% maximum

Environmental Index	50 pts
District Factors/Flexible Points	50 pts
Total	**100 pts**

Safety
Weight: 5% minimum - 25% maximum

Safety Index	70 pts
Safety Concern	10 pts
Safety Enhancements	10 pts
District Factors/Flexible Points	10 pts
Total	**100 pts**

Taking Care of the System
Weight: 75% minimum - 95% maximum

Roadway

Pavement Smoothness	30 pts
Pavement Condition	20 pts
Functional Classification	10 pts
Daily Usage (all vehicles)	10 pts
Truck Usage	10 pts
Substandard Roadway Features	10 pts
District Factors/Flexible Points	10 pts
Total	**100 pts**

- OR -

Bridge

Bridge Cndition	40 pts
Exceptional Bridge	10 pts
Functional Classification	10 pts
Daily Usage (all vehicles)	10 pts
Truck Usage	10 pts
Substandard Bridge Features	10 pts
District Factors/Flexible Points	10 pts
Total	**100 pts**

- **The glossary explains how each factor is scored.**
- **MoDOT Districts will allocate 20% of the weight among all investment goals.**
- **"District Factors/Flexible Points" may be used to capture unique items that are important to an individual region or can be allocated among existing factors.**
- **The weight of investment goals must meet minimum and maximum percentages noted above. The total weight of all investment goals must equal 100%.**

Table 5.61: Regional and Emerging Needs Projects

Prioritization Process

Regional and Emerging Needs Projects
11/04/2003

Regional and Emerging Needs Projects

This process does not apply in TMA areas

Access to Opportunity
Weight: 5% minimum - 30% maximum

Vehicle Ownership	25 pts
Eliminate Bike/Ped Barriers	25 pts
District Factors/Flexible Points	50 pts
Total	**100 pts**

Congestion Relief
Weight: 5% minimum - 50% maximum

Level of Service	20 pts
Daily Usage	20 pts
Functional Classification	20 pts
System Efficiency (w/o Expansion)	20 pts
District Factors/Flexible Points	20 pts
Total	**100 pts**

Economic Competitiveness
Weight: 5% minimum - 30% maximum

Supports a Strategic Economic Corridor	20 pts
Level of Economic Distress	20 pts
Supports Regional Economic Development Plans	20 pts
District Factors/Flexible Points	40 pts
Total	**100 pts**

Efficient Movement of Freight
Weight: 5% minimum - 30% maximum

Truck Volume	50 pts
Freight Bottlenecks	25 pts
District Factors/Flexible Points	25 pts
Total	**100 pts**

Quality of Communities
Weight: 5% minimum - 30% maximum

Complies with Local/Regional Land-Use Plans	25 pts
Connectivity	25 pts
District Factors/Flexible Points	50 pts
Total	**100 pts**

Environmental Protection
Weight: 5% minimum - 30% maximum

Environmental Index	50 pts
District Factors/Flexible Points	50 pts
Total	**100 pts**

Safety
Weight: 15% minimum - 40% maximum

Safety Index	50 pts
Safety Concern	25 pts
District Factors/Flexible Points	25 pts
Total	**100 pts**

Taking Care of the System
Weight: 5% minimum - 30% maximum

Bridge Condition (of bridge to be replaced) **OR** Pavement Condition (of lanes to be replaced)	25 pts
Substandard Roadway **OR** Substandard Bridge Features	25 pts
District Factors/Flexible Points	50 pts
Total	**100 pts**

- The glossary explains how each factor is scored.
- MoDOT Districts will allocate 50% of the weight among all investment goals. In addition, "District Factors/Flexible Points," maybe used to capture unique items that are important to an individual region or they may be allocated among existing factors.
- The weight of investment goals must meet minimum and maximum percentages noted above. The point values listed with each factor are recommendations and may be changed at the district's discretion.
- The total weight of all investment goals must equal 100%.
- MPOs designated as Transportation Management Areas may develop their own regional and emerging needs prioritization process, subject to certification by MoDOT.

Table 5.62: Safety Projects

Safety Projects

Prioritization Process

Safety Projects
11/04/2003

This process applies to all areas of the state

Access to Opportunity
Weight: 0%

Congestion Relief
Weight: 10%

Daily Usage	90 pts
District Factors/Flexible Points	10 pts
Total	**100 pts**

Economic Competitiveness
Weight: 0%

Efficient Movement of Goods
Weight: 0%

Quality of Communities
Weight: 0%

Environmental Protection
Weight: 0%

Safety
Weight: 90%

Safety Index	40 pts
Accident Severity	25 pts
Accident Rate	20 pts
Safety Concern	5 pts
Safety Enhancements	5 pts
District Factors/Flexible Points	5 pts
Total	**100 pts**

Taking Care of the System
Weight: 0%

- **The glossary explains how each factor is scored.**
- **Because this is a more data intensive process with a higher level of desired statewide consistency, the investment goals are fixed.**
- **There are "District Factors/Flexible Points" in this process to capture unique items that are important to an individual region; or these points may be allocated among existing factors.**

Table 5.63: Major Projects: System Expansion

Major Projects: System Expansion

New major roadway, new bridge and roadway expansion projects

Prioritization Process

Major Projects: System Expansion
11/04/2003

This process does not apply in TMA areas

Access to Opportunity	
Weight: 5%	
Vehicle Ownership	75 pts
Eliminate Bike/Ped Barriers	25 pts
Total	**100 pts**

Congestion Relief	
Weight: 30%	
Level of Service	40 pts
Daily Usage	30 pts
Functional Classification	30 pts
Total	**100 pts**

Economic Competitiveness	
Weight: 15%	
Strategic Economic Corridor	40 pts
Level of Economic Distress	30 pts
Supports Regional Economic Development Plans	30 pts
Total	**100 pts**

Efficient Movement of Freight	
Weight: 5%	
Truck Volume	60 pts
Freight Bottlenecks	20 pts
Intermodal Freight Connectivity	20 pts
Total	**100 pts**

Quality of Communities	
Weight: 5%	
Complies with Local/Regional Land-Use Plans	50 pts
Connectivity Between Cities/Regions	50 pts
Total	**100 pts**

Environmental Protection	
Weight: 5%	
Environmental Impact	100 pts
Total	**100 pts**

Safety	
Weight: 30%	
Safety Index	80 pts
Safety Concern	20 pts
Total	**100 pts**

Taking Care of the System	
Weight: 5%	
Bridge Condition (of bridge(s) to be replaced/rehabbed)	40 pts
Pavement Condition (of lanes to be replaced/rehabbed)	40 pts
Substandard Roadway Features	20 pts
Total	**100 pts**

- **The glossary explains how each factor is scored.**
- **Because this is a statewide process, there is no flexibilty in investment goal weight.**

As seen from these tables, each of the eight criteria have between 2 and 9 performance measures used to evaluate projects.

For the Efficient Movement of Freight criterion, up to four measures are used in the ranking: Truck Volume, Freight Bottlenecks, Intermodal Freight Connectivity, and District Factors/Flexible Points. Not all of these measures are used to evaluate the Efficient Movement of Freight for each project type. These measures are defined and the points indicated in the scorecard are awarded as shown below.

Truck Volume is scored by the following formula, where TU is total commercial volume (TU = Estimated Volume of Trucks/#of Through driving Lanes) (*MoDOT 2004*, p. 59):

$$\boldsymbol{TotalPoints = (2.5 \times TU)^{1/2} \div 100 \times TPV}$$

Where TPV is the total number of points allocated to this factor.

Freight Bottlenecks are awarded points depending on the answer to the question "Does this project eliminate a freight bottleneck?" The full point value is awarded to a "Yes", zero points to a "No" response.

Intermodal Freight Connectivity is scored by asking whether the project is a link to an intermodal facility or if the project provides a better connection with an intermodal freight facility. If the answer is "yes", this factor receives full point value indicated in the following tables; if the answer is "No", then zero points are assigned.

District Factors/Flexible Points are flexible points which may be assigned to factors decision-makers deem important, or they may be used to increase the point value of existing measures. These flexible points can be applied to any criteria (*MoDOT 2004*, p. 52).

The other Criteria receive similar disparate weights and use of measures across project types. Most of the measures used are categorical where the "Yes" or "No" response to a question either give the factor total point value (TPV) or zero points. For instance, the Environmental Index is the response to the question "Does the project require environmental mitigation?" If the answer is "Yes", the project receives zero points for this factor; if "No", it receives full point value.

5.1.4.3 Summary/Analysis

The Missouri scorecard has the benefit of using the same criteria for different types of highway projects. However, given the variation in the measures used for each Criteria across highway project types and the differences in weights, it is difficult to see how comparisons can be reliably made even across highway projects.

While the scorecard looks well developed, the performance measures are not. Most of the "measures" are simply categorical "Yes/No" responses for which either full point value is given or zero points are. This prevents the scoring system from measuring the intensity of the response.

While the general scorecard framework seems pretty useful and the Criteria are the same across project types, more standardization of the measures used for each type of project and better measures (data/metric driven measures rather than Yes/No types of responses) are needed to improve this approach.

5.1.5 Puget Sound Scorecard Evaluation

The Puget Sound Regional Council (PSRC) scorecard uses nine Criteria each equally weighted in the process of project prioritization. In addition, a benefit cost ratio is also provided to decision-makers so the final prioritization process makes use of both types of methodologies for project selection.

The nine Criteria are:

- Air Quality (Maximum of 10 points)
- Freight (Maximum of 10 points)
- Jobs (Maximum of 10 points)
- Multi-Modal (Maximum of 10 points)
- Puget Sound Land and Water (Maximum of 10 points)
- Safety and System Security (Maximum of 10 points)
- Social Equity and Access to Opportunity (Maximum of 10 points)
- Support for Centers (Maximum of 10 points)
- Travel (Maximum of 10 points)

Table 5.64 is a template for the final comparative scorecard. Each of the nine criteria has a column with a clear, comparable benefit rating for every project with a full dark circle as 'smallest benefit' to a red donut as the 'largest benefit'. Along with an overall score averaged from the criteria scores, the scorecard utilizes a cost benefit approach as well to further compare projects.

Table 5.64: Puget Sound Scorecard Template (*PSRC 2012a*, p. 10)

T-2040 PRIORITIZATION - SCORECARD - HIGHWAY PROJECTS

PROJECT	AIR QUALITY	FREIGHT	JOBS	MULTI-MODAL	PUGET SOUND LAND & WATER	SAFETY & SYSTEM SECURITY	SOCIAL EQUITY & ACCESS TO OPPORTUNITY	SUPPORT FOR CENTERS	TRAVEL	SCORE	COST	BENEFIT	NET BENEFIT	BC RATIO
PROJECT A	◓	◓	◓	◓	◓	○	◓	◓	○	7	$ 36	$ 357	$ 322	10.0
PROJECT B	◓	◎	◎	◎	○	○	◓	◡	○	7	$ 503	$ 2,474	$ 1,971	4.9
PROJECT C	○	○	◓	◓	○	○	○	◓	○	3	$ 34	$ 127	$ 93	3.7
PROJECT D	◓	◓	○	○	◓	◡	○	○	○	2	$ 259	$ 310	$ 52	1.2

Scoring symbols: ◎ Largest benefit; ◓ Larger benefit; ○ Average benefit; ◡ Smaller benefit; ● Smallest benefit

All dollar values are in millions and represent totals in present terms.

Each Criterion has one or more measures, some with a specific quantitative component and others that are rated based on the evaluator's judgment. The scoring guide for each is explained below.

5.1.5.1 Air Quality (10 Points Maximum)

The Air Quality Criteria has four performance measures which are defined and for which scores are specified in the following manner.

1. VMT and Trip Reduction (Maximum 5 points)

To receive the full 5 points, a project is expected to reduce total VMT and reduce the total number of trips. If the number of projected trips does not change, then the project is given a score of 3 (*PSRC 2013*, p. 4).

2. Improving Traffic Flow (Maximum 2 points)

To receive the full 2 points, a project must improve freight flow and reduce idling time by trucks. One point is given if the project improves traffic flow in another way. (*PSRC 2013*, p. 4).

3. Emissions Mitigation in Sensitive areas (Maximum 1 point)

This point is given if a project is not within ¼ miles of a location with attendees sensitive to air pollution, or if the project uses alternative technologies to mitigate pollution within these areas (*PSRC 2013*, p. 5).

4. Alternative Energy Technology (Maximum 2 points)

If the project incorporates EV charging stations, new transit infrastructure or service of another kind of alternative energy, then the project receives 2 points. It receives zero points otherwise (*PSRC 2013*, p. 5).

5.1.5.2 Freight (10 Points Maximum)

The Freight Criteria has several performance measures which are defined and for which scores are specified in the following manner:

1. Improves Bottleneck (Maximum 3 points)

If the project addresses a known freight bottleneck, it receives 3 points.

2. Freight Conflict (Maximum 1 point)

If the project reduces conflict between freight modes, it receives 1 point.

3. Freight/Passenger Conflict (Maximum 1 point)

If the project reduces conflict between freight and one or more passenger modes, receives 1 point.

4. Connectivity (Maximum 3 points)

A project either receives 2 points for connectivity if it improves access within, to or between more than one Manufacturing and Industrial Centers (MICs) or between an MIC and a Regional Growth Center (RGC) OR it receives only one point if it only improves access within or to only one MIC.

One point is given if the project touches or is inside a Transportation Analysis Zone (TAZ) containing a freight generator (*PSRC 2013*, p. 7).

5. Key Freight Facility (Maximum 2 points)

If the project is on a route designated as a key freight route (designated by the PSRC using GIS data to identify either T-1 or T-2 routes) it receives 2 points (*PSRC 2013*, p. 8).

5.1.5.3 Jobs (Maximum 10 points) (See Table 5.65 below)

The Jobs Criteria has four performance measures which are defined as following:

1. Job Expansion (3 points or 1 point)

The measure of employment density for this metric is derived from PSRC employment data and their UrbanSim land use model and depends on whether the area served by the project has employment density of 18 jobs per acre (1 point) or has 18 jobs per acre and is planned to achieve 32 jobs per acre (3 points). This is cluster employment. (*PSRC 2013*, p. 8).

2. Cluster Employment (Maximum 2 points)

This measure also uses the PSRC employment data, and awards points for a project intersection or a boundary being within 10ft of the cluster employment Industry clusters are those identified in the PSRC/Prosperity Partnership's Regional Economic Strategy (adopted 2005 (*PSRC 2013*, p. 10).

3. Family Wage Employment (Maximum 2 points)

This measure also uses the PSRC employment data and an estimation of family wages at the county level, and awards points for intersection or a boundary (10ft) with employment areas that have a density of 15 jobs per acre. (*PSRC 2013*, p. 10).

4. Access to Economic Foundations (Maximum 3 points)

Points are awarded if the project borders a job training facility or if the Sponsor believes that there is significant access to these facilities even without a border (*PSRC 2013*, p. 10).

Points are allocated to each of the Job measures as indicated in Table 5.65:

Table 5.65: Jobs Scoring Guide (*PSRC 2012b*, p. 3)

	Purpose: Access to areas of high job concentration. How well does the project support job retention or expansion by improving access?		
Points	Choose one	3	The area served by this project has an employment density[6] of 18 jobs per acre, and is planned (has unused zoned capacity) to accommodate a density of 32 jobs per acre. (Areas that currently exceed the higher threshold would receive points here as well).
		1	The area served by this project has an employment density of 18 jobs per acre.
	2		The area served by this project has an employment density of 15 jobs per acre for jobs related to cluster employment.[7]
	2		The area served by this project has an employment density of 15 jobs per acre for family-wage related employment.
	Purpose: Access to economic foundations. How well does the project provide access to job-related training or educational opportunities (vocational schools, community colleges, universities)?		
	3		In area with, or supports access to institutions identified as economic foundations.
Total	10 (max)		

5.1.5.4 Multimodal

Table 5.66 shows the scoring guide for the Multimodal criteria:

Table 5.66: Multimodal Scoring Guide (*PSRC 2012b*, p. 4)

	Purpose: Improve alternatives to driving alone. How well does the project improve mobility through alternatives to driving alone?	
	2	The project improves opportunities for transit, special needs transportation services, or vanpool use (may include intermediary facilities such as Park and Rides).
	2	The project adds incentives[8] or removes barriers[9] for individuals to use fixed-route transit, special needs transportation services, or vanpools.
	1	The project improves opportunities for bicycle and pedestrian travel.
	1	The project implements a portion of the regional bicycle network[10], and is included in a local plan.
	2	The project adds incentives or removes barriers for individuals to use non-motorized travel modes.
	1	The project includes additional tools or strategies to reduce the proportion of drive-alone trips[11]
	Purpose: Improve connections between transit and non-motorized modes. How well does the project improve connections between modes of travel, especially for bicyclists and pedestrians accessing transit?	
	1	The project improves bicycle and pedestrian access within ¼ mile of a (MTS[12]) transit stop.
Total	10 (max)	

The performance measures for multimodal criteria scoring are defined as follows:

1. Improves Opportunities for Transit and Alternative Services (Maximum 2 points)

Points are awarded if the project improves opportunities for transit, special needs services or vanpools.

2. Incentives or Removing Barriers (Maximum 2 points)

Points are awarded if the project offers incentives, including subsidized travel programs, or increases infrastructure to remove barriers. No points are awarded if these measures are not met *(PSRC 2013*, p. 12).

3. Bicycle and Pedestrian Travel (Maximum 1 point)

Points are awarded if the project addresses bike and pedestrian needs (*PSRC 2013*, p. 12).

4. Regional Bicycle Network (Maximum 1 point)

If the project will improve the regional bike network laid out in the PSRC's Active Transportation Plan, then a point is awarded (*PSRC 2013*, p. 12).

5. Access to non-motorized travel modes (Maximum 2 points)

This measure awards points for incentives for, or removal of barriers to, non-motorized vehicles. (*PSRC 2013*, p. 12).

6. Reduction of Drive-Alone Trips (Maximum 1 point)

This metric awards a point to projects that include car sharing, carpooling and telecommuting strategies (*PSRC 2013*, p. 12).

7. Connectivity to Non-motor Modes (Maximum 1 point)

A point is awarded if the project improves bike and pedestrian access to a Metropolitan Transportation System (MTS)(*PSRC 2013*, p. 12).

5.1.5.5 Puget Sound Land and Water (Maximum 10 points)

This criterion has four major categories for which points are allocated according to Table 5.67.

Table 5.67: Land and Water Scoring Guide (*PSRC 2012b*, p. 5)

	Purpose: Protect critical areas. How well does the project minimize critical area and habitat loss, alteration and fragmentation in designated lands?		
	Choose one	4	The project improves critical areas or habitat on designated lands.
		3	The project does not affect critical areas or habitat on designated lands[13].
		2	If the project affects critical areas, it helps to restore the critical areas or habitats
		1	If the project affects critical areas, it effectively mitigates impacts to designated critical areas and habitats
	Purpose: Protect resource lands. How well does the project minimize impact to designated forest and agricultural lands?		
	2		The project does not impact designated agricultural lands
	2		The project does not impact designated forest lands
	Purpose: Improve water quality[14]. How well does the project improve water quality by improving hydrological functions and/or reducing stormwater runoff?		
	Choose One	2	The project uses practices for improving hydrological functions that go beyond established stormwater standards, or the project improves stormwater runoff.
		1	The project is designed to reduce stormwater runoff.
Total	10 (max)		

Definitions and derivation of information for use in this table are described here:

1. Protect Critical Areas (Maximum 4 points)

Restoration or mitigation are considered improvements even if they do not return the ecosystem to a close approximation of its condition prior to disturbance. Maps of critical areas are provided using preconstructed GIS layers (*PSRC 2013*, p. 15).

2. Protect Agricultural Lands (Maximum 3 points)

Agricultural lands are designated using GIS mapping (*PSRC 2013*, p. 15).

3. Protect Forest Lands (Maximum 2 points)

Forest lands are designated using GIS mapping (*PSRC 2013*, p. 15).

4. Improve Water Quality (Maximum 1 point)

The standards referenced in Table 5.67 are based on the Washington Department of Ecology's storm water requirements (*PSRC 2013*, p. 16).

5.1.5.6 Safety and System Security (Maximum 10 points)

The scoring of Safety and Security uses two measures:

1. Design-Related Crashes (Maximum 8 points)

Geometric issues are design-related. 8 points are awarded if the project will improve a segment identified by Washington State's Target Zero, a plan to eliminate fatalities by 2030, relating to design-related crashes (*PSRC 2013*, p. 18). 6 points are awarded if the project improves safety on a facility with existing injury accidents related to geometric issues. 4 points are awarded if the project improves safety on a facility with existing property damage incidents related to geometric issues. (*PSRC 2012b,* p. 6)

2. System Security (Maximum 2 points)

The Transportation Recovery Annex provides a list of facilities crucial for recovering the transportation system after catastrophic events. If the project improves the security of these facilities, 2 points are awarded (*PSRC 2013*, p. 18).

5.1.5.7 . Social Equity and Access to Opportunity

This criterion uses three measures, each having a maximum of 2 -4 points.

1. New Environmental Health Impacts (Maximum 2 points)

If a project is located within areas that have a high density of specific populations listed, and does not avoid negative impacts on those populations, then it does not receive points for this measure. If it does help avoid negative impacts, it receives 2 points. (*PSRC 2013,* p. 20).

2. Improving Environmental Health (Maximum 4 points)

An improvement to environmental health is assumed to correspond to an improvement in human health. Thus, according to the PSRC, "… the intent of these questions is to identify projects providing opportunities for increased physical activity, encouraging healthy community design such as complete streets, improving air quality, etc." Points (2, 3, or 4) are awarded depending on how many populations are impacted (*PSRC 2013*, p. 20).

3. Improving access to Opportunity (Maximum 4 points)

This measure receives a score of 4 if the project connects two areas with low ranking for opportunity, 2 points if it improves access to a low opportunity area, and 1 point if it improves access to a high opportunity area. These areas are defined by the Growing Transit Communities opportunity mapping.

Table 5.68 provides a summary of scoring for this criterion.

Table 5.68: Social Equity and Access to Opportunity Scoring (*PSRC 2012b*, p. 7)

	Purpose: Improve environmental health. How well does the project avoid creating new, mitigate existing, or eliminate previous negative impacts for the following populations: minority, low-income, elderly, youth, people with disabilities, and households without vehicles.		
Points	2		The project avoids creating new negative environmental health impacts or physical barriers for these populations[17]
	Choose one	4	The project improves environmental health for three or more of these populations
		3	The project improves environmental health for two of these populations
		2	The project improves environmental health for one of these populations
	Purpose: Improve access to opportunity. How well does the project improve access to areas of opportunity?		
	Choose one	4	The project improves access[18] to an area with a low ranking for opportunity and connects it with an area with a high ranking for opportunity (as defined by the Growing Transit Communities opportunity mapping[19]).
		2	The project improves access to an area with a low ranking for opportunity (as defined by the Growing Transit Communities opportunity mapping).
		1	The project improves access to an area with a high ranking for opportunity (as defined by the Growing Transit Communities opportunity mapping).
Total	10 (max)		

5.1.5.8 Support for Services

Scoring for Support for Service Criteria is shown in Table 5.69.

Table 5.69: Support for Services Scoring Guide (*PSRC 2012b*, p. 8)

	Purpose: Access to Regional Growth Centers. How well the does the project provide increased mobility and accessibility for regional growth center(s)?[20]		
Points	Choose One	5	Provides increased mobility and accessibility within a regional growth center
		3	Provides increased mobility and accessibility by connecting[21] two or more regional growth centers (or connects to a regional manufacturing industrial center)
		2	Provides increased mobility and accessibility by connecting into one regional growth center
	Purpose: Access to transit supportive land use. How well is the project supported by the following land use and planning characteristics?		
	Choose One	2	Existing development densities are transit supportive[22] (have housing densities greater than 15 homes per gross acre)
		1	Existing development densities are transit supportive (have housing densities greater than eight homes per gross acre)
	1		Comprehensive plan or subarea plan specifically identifies the area as a location for additional transit supportive growth
	1		Project area is designated as a high capacity transit station area (includes light rail, commuter rail, bus rapid transit, intermodal stations, ferry terminal)
	1		Zoning in area encourages a mix of uses to provide for housing, jobs, and services
Total	10 (max)		

1. Access to Regional Growth Centers (Maximum 5 points)

Access to Manufacturing and Industrial Centers (MICs) and Regional Growth Centers (RGCs) exists if the project touches, passes through or is inside a center as designated by the PSRC (*PSRC 2013*, p. 22).

2. Existing Transit Supportive Development (Maximum 2 points)

Density data is calculated using the PSRC UrbanSim land use model (*PSRC 2013*, p. 22) and points are assigned as in Table 5.69.

3. Transit Supportive (1 point Maximum)

One point is awarded if the project meets a transit need outlined in the PSRC comprehensive plan or a sub-regional plan (*PSRC 2013*, p. 22).

4. Transit Station (1 point Maximum)

One point is awarded if the project area is designated as a high capacity transit station.

5. Density Zoning (1 point Maximum)

One point is awarded depending the current PSRC zoning conditions (see Table 5.69).

5.1.5.9 Travel

The Travel Criteria scoring is based on three performance indicators as indicated in Table 5.70.

Table 5.70: Travel Scoring Guide (*PSRC 2012b*, p. 9)

	Purpose: Reduction of existing congestion issues. How well does the project improve existing travel problems? How large is the scale of the travel problem the project addresses?	
Points	4	The corridor where the project is located is identified as an existing bottleneck, chokepoint, or otherwise having a congestion issue through the Congestion Management Process, WSDOT's Highway System Plan, or other adopted agency plan.
	2	The project provides a demonstrable travel improvement for an identified problem that occurs during the peak hours of travel, (in addition to peak hours the failure may also occur at other times of the day).
	Purpose: Reduction of potential future congestion issues. How well does the project improve future travel problems?	
	2	The project provides a demonstrable travel improvement on a facility anticipated to have a future congestion issue, identified through an adopted plan.
	Purpose: Improvement of system efficiency. How does the project improve throughput?	
	2	The project employs Transportation System Management, Intelligent Transportation Systems, Tolling, High Occupancy Vehicle, and/or is supportive of transit.
Total	10 (max)	

1. Bottlenecks (Maximum 4 points)

Bottlenecks and choke points are mapped using GIS by WSDOT and, if the project is on one of these corridors, it is given 4 points. (*PSRC 2013*, p. 24).

2. Peak Travel (Maximum 2 points)

Points are awarded if the project involves a travel improvement for a problem that occurs at peak travel time.

3. Future Congestion (Maximum 2 points)

2 points are awarded if the project is an improvement on a facility identified in a plan as having future congestion.

4. Improvement of System Efficiency (Maximum 2 points)

PSRC defines a project as 'supportive of transit' if it "provided new facilities, included dedicated rights-of-way like Business Access Transit lanes, improved transit and bicycle/pedestrian connections, park and rides, and transit centers". 2 points are awarded if the project meets this expectation or employs advanced technologies as indicated in Table 5.70. (*PSRC 2013*, p. 24).

5.1.6 Summary: Evaluation of Tools and Their Utility across Modes for Scorecard Methodologies

Most of these case studies have very detailed methodologies for the evaluation and ranking of highway projects, but most do not have comparable methodologies for the other modes (rail, port, and airport investment).

Where ranking methodologies have been developed for non-highway investment modes, they often include different criteria for evaluation. In particular, non-highway modes almost always have a category for the diversion of traffic from the highway mode. This measure is significant because traffic diversion is used subsequently in benefit-cost analysis, and the traffic diversion is also used to calculate the change in emissions resulting from the investment in the non-highway mode.

The values used for the diversion of traffic from highway almost always are assumed to be equal to the increased traffic forecast for the new and improved alternative mode's infrastructure. This assumption means all of the estimates of benefits from traffic diversion are made using the maximum traffic diversion possible. Thus, evaluation of net benefits (in terms of volumes, dollars, and emissions) is likely to be overestimated.

For instance, in the evaluation of rail projects the forecast increase in rail TEU is assumed to be equal to a decrease in an equal amount of TEU (converted into truck volumes) from the roads. This assumption is not supported by empirical analysis of mode choice by shippers. In fact, investment in rail infrastructure that improves or expands capacity will lower the cost of rail to users (through reducing either time in transit or wait time for a shipment to be picked up), thus

stimulating demand for rail service. How much this change in cost affects shipper's mode choice depends on which industries are impacted (agricultural, high tech, manufacturing, etc.) and how responsive each is to a change in rail costs. For many shippers of high-value commodities, they will not switch to rail even if there is a substantial change in rail costs. If rail improvements are made in an agricultural region, however, there may be considerable mode switching in response to an investment. Finally, improved rail service may simply help deal with the growth in traffic due to population and income growth and not result in any diversion of existing traffic from highways.

This issue arises in both scorecard and benefit-cost methodologies which will result in the net benefits from non-highway investment to be overestimated.

Another category where implementation varies is in the definition and measurement of the general category "Environmental" or "Emissions". Some states use detailed information on the wetlands/site specific environmental impact whereas others focus on air emissions. Emissions calculations are easily made using EPA estimates of particulates for various fuels once a credible number is estimated for the change in traffic. However, as noted above, the change in truck traffic assumed is usually vastly overestimated in these methodologies when considering non-highway modes.

For highway, a change in air emissions is often not considered at all---implicitly assuming that highway investment will not impact emissions one way or another.

Further, in the evaluation of highway projects, safety is usually measured explicitly as changes in various accident rates. For rail, little effort has been made to make a comparable measure. Rather, when rail safety is considered, rail is simply assumed to be safer than highway travel. Given the efforts made to improve the safety of rail crossings and known derailments, actual data on rail safety should be used in these evaluations.

A summary of the evaluated tools is available in Table 5.71. The metrics were categorized using the researchers judgment to identify themes.

Table 5.71: Overall Categories of Benefits Considered by the Examined Scorecard Tools

location	Florida	Maryland	Missouri	Ohio	Puget Sound (WA region)
tool	SIS Investment Tool	Freight Evaluation Criteria	Function Needs Prioritization Process	TRAC Scorecard	Scorecard
mode	Highway	Highway, Rail	Road, Bridge (waterway)	Road, Bridge, (all)	Highway
General mobility/ congestion relief, may include freight-specific measures	connector location, v/c ratio, truck volume, vehicular volume, system gap, change in v/c-LOS or Interchange operations, bottleneck/grade separation, delay	AADT,v/c ratio	LOS, daily usage, functional classification	v/c ratio, ADTT, peak hour ridership/capacity, VMT reduction	travel
Safety and security	crash ratio, fatal crash, bridge appraisal rating, link to military base	crash rate, development of inspection/weigh station	safety index, safety concern, safety enhancements	crash density/frequency, severity, crash ratio	safety and system security
Environmental stewardship	land and social criteria, geology criteria, habitat criteria, water criteria		environmental index	air quality, emissions reduction	air quality, Puget Sound land & water
System preservation/ addressing deficient conditions/ maintenance	v/c ratio, truck volume, vehicular volume, bridge condition rating		substandard roadway or bridge features, pavement smoothness, pavement condition, functional classification, daily usage (all vehicles), truck usage, bridge condition, exceptional bridge	functional class	
Economics & competitiveness	demographic preparedness, private sector robustness, tourism intensity, supporting facilities		level of economic distress, supports regional economic development plans	economic impact, considering factors of economic distress, adopting appropriate land use measure, positioning land for redevelopment	
Land use and development plans		reinforce the development of freight-related land uses within existing freight activity centers or direct new development to PFAs and sites with adequate infrastructure	connectivity, complies with regional or local transportation plans		support for centers
Connectivity for freight mobility		enhance connectivity between freight modes and/or improve access to clusters of freight-intensive industries	connectivity, complies with regional or local transportation plans	intermodal connectivity	multi-modal
Reduces transportation costs					
Freight-specific mobility			truck volume, freight bottlenecks, intermodal freight connectivity	intermodal connectivity, AADT, v/c ratio	freight
New or retained jobs					jobs
Miscellaneous	land and social criteria, geology criteria, habitat criteria, water criteria	coordination: to fulfill the plans, programs, or goals of multiple agencies	access to opportunity: Vehicle Ownership, eliminate bike/ped barriers		

5.2 SECTION 2: BENEFIT-COST METHODOLOGIES

The four benefit-cost methodologies selected for consideration here are:

- Puget Sound Regional Council (PSRC) Benefit-Cost Tool
- FAA Airport Benefit-Cost Analysis Guidance
- TIGER Grants
- WSDOT Freight Rail Benefit Cost

The benefit-cost analysis tools discussed all follow the same general methodology:

1. Identify the motivation for the project
2. Identify an appropriate base case
3. Consider adequate and relevant alternatives
4. Quantify benefits and costs
5. Discount to present value
6. Compare benefits to costs to identify acceptable or optimal alternatives

Details of these methodologies are discussed in the following sections. Most of the benefit-cost methodologies use data produced by travel demand models and then assign to those data a dollar value. The question most addressed is the appropriate dollar values to assign to each element.

5.2.1 PSRC Benefit Cost

Perhaps because their benefit-cost analysis is one component of their scorecard, the benefit-cost tool used by PSRC is straightforward, relying only on travel demand model output.

Because the results rely so heavily on the travel model, the level of detail that is possible in their BCA analysis is limited by the model output aggregation. The methodology used in the PSRC BCA tool is the same as used in the AASHTO “Red Book” and is implemented in software developed by ECONorthwest to convert their regional travel model output (EMME/3) to monetary values in format readable by standard spreadsheet software.

The steps used in their BCA are relatively consistent with the other examined BCA tools:

1. Define the Project Alternative and the Base Case.

2. Determine the level of detail (spatial, temporal, user segmentation, etc.) required.

3. Develop basic user cost factors (values of time, vehicle unit operating costs, accident rate and cost parameters, vehicle emission rate and cost parameters, etc.).

4. Select economic factors (discount rate, analysis period, evaluation date, inflation rates, etc.)

5. Obtain traffic performance data (for Project Alternative and Base Case) for explicitly modeled periods.

6. Measure user costs (for Project Alternative and Base Case) for affected link(s) or corridor(s)

7. Calculate user benefits.

8. Extrapolate/interpolate benefits to all project years (unless all time periods are explicitly modeled).

9. Determine present value of benefits, costs.

(*PSRC 2009*, p. 7 and *PSRC 2010*, p. 5)

Seven key measures are included within the BCA tool: Travel time savings, accident cost savings, vehicle operating and ownership cost savings, travel time un-reliability savings, facility operating cost impacts, facility capital cost impacts, vehicle emissions costs. All of these measures are derived from travel model output and then monetized.

5.2.1.1 Benefits and Values

Travel time savings is valued according to the wage rate of passengers or the wage paid to drivers plus the time cost of cargo for commercial vehicles. Based on a PSRC GPS Traffic Choices Study, passenger value of time was established for this region at 75 percent of the wage rate. Truck value of time was not gathered as part of this effort, and they rely on a literature review and the insights from the passenger vehicle values from the Traffic Choices Study to inform truck values of time, ranging from $40 to $50 per hour for three truck classes (light, medium, and heavy). (*PSRC 2009* p. 9) The values of time, by vehicle type, trip type and time period are listed in Table 5.72 (*PSRC 2010*, p. 17).

Table 5.72: PSRC Values of Time (*PSRC 2010*, p. 17)

	Income Quartile 1	**Income Quartile 2**	**Income Quartile 3**	**Income Quartile 4**
Home-based work (HBW) Drive OR HBW In Transit Vehicle	9.57	17.64	25.71	33.33
HBW Wait for Transit OR HBW Walk to Transit	23.94	44.14	64.32	83.39
	Not Income Quartile based			
Heavy trucks	50.00			
Medium Trucks	45.00			
Light Trucks	40.00			
Other (non-home-based work) Driving	15.68			
Other In Transit Vehicle	10.00			
Other Wait for Transit OR Other Walk to Transit	25.02			
Shared Ride (2-person)	19.29-30.14 (depending on time of day)			
Shared Ride (3-person)	20.50-38.09 (depending on time of day)			
Vanpool	21.28-101.73 (depending on time of day)			

Travel time reliability is valued according to willingness-to-pay to reduce risk. They have developed a conversion rate with a volume-delay function to convert travel time uncertainty to travel time. They then incorporate this additional travel time into their network assignment and into the BC tool. Once the unreliability is converted to a travel time, it is monetized using value of time.

Accident Cost Savings rely on industry-standard values for property damage only ($2,600), Injury ($75,500), and Fatality ($2,500,000). (*PSRC 2009* p. 10)

Vehicle Operating and Ownership Cost Savings are estimated in per mile values based on forecasts (Auto: 0.15, Light Trucks: 0.15, Medium Trucks: 0.78, Heavy Trucks: 0.78) (*PSRC 2009* p. 10, *PSRC 2010* p. 22).

Facility operating cost impacts are estimated using governmental data and models. Facility capital cost impacts are accounted for with project estimates and uncertainty in cost overruns can be accounted for with sensitivity analysis within the benefit-cost analysis.

Vehicle Emissions Costs are based on effects on health of people, plants and property. The travel model results (changes in travel patterns by speed, volume, and functional

class) are adjusted by the EPA's Motor Vehicle Emission Simulator (MOVES) model values (to convert travel miles to emissions), and then those emissions are monetized. The emission rates are developed using the MOVES model and then converted to monetary values using the middle of available estimates from the literature. The resulting values per ton used as default values are Carbon Dioxide (32.0 $/ton), Carbon Monoxide (380.0 $/ton), Nitrogen Oxide (9800.0 $/ton), Volatile Organic Compound (7800.0 $/ton), and Particulate 2.5 (6500.0 $/ton). (*PSRC 2009* p. 10, *PSRC 2010* p. 23). The default vehicle emission rates by pollutant and vehicle type are listed in Table 5.73 (*PSRC 2010*, p. 23).

Table 5.73: PSRC Default Vehicle Emission Rates (*PSRC 2010*, p. 23)

Figure 3-8. Default Vehicle Emissions Rates in 2040 (Tons per Mile)

Pollutant	Speed Class	Car	Light Truck	Medium Truck	Heavy Truck
Carbon Dioxide	0	1367.87	1911.392	5260.83	5260.83
Carbon Dioxide	10	703.6223	979.6333	2604.637	2604.637
Carbon Dioxide	20	449.742	599.1229	1885.247	1885.247
Carbon Dioxide	30	375.1467	490.2579	1648.99	1648.99
Carbon Dioxide	40	353.9383	453.5595	1471.327	1471.327
Carbon Dioxide	50	347.6133	436.1347	1410.2	1410.2
Carbon Dioxide	60	356.3313	432.2829	1299.983	1299.983
Carbon Monoxide	0	21.28757	21.13314	9.160357	9.160357
Carbon Monoxide	10	13.9473	14.66225	5.04355	5.04355
Carbon Monoxide	20	12.4957	13.44995	2.91505	2.91505
Carbon Monoxide	30	12.26605	13.3525	2.08155	2.08155
Carbon Monoxide	40	12.8884	14.09565	1.86755	1.86755
Carbon Monoxide	50	13.7746	14.97025	2.14925	2.14925
Carbon Monoxide	60	14.61675	15.56575	2.675875	2.675875
Nitrogen Oxide	0	0.605071	0.692429	0.505643	0.505643
Nitrogen Oxide	10	0.43895	0.50575	0.40155	0.40155
Nitrogen Oxide	20	0.3965	0.4545	0.3406	0.3406
Nitrogen Oxide	30	0.3887	0.4427	0.32715	0.32715
Nitrogen Oxide	40	0.3973	0.451	0.3572	0.3572
Nitrogen Oxide	50	0.4163	0.46525	0.4501	0.4501
Nitrogen Oxide	60	0.431375	0.475625	0.565375	0.565375
Volatile Organic Compound	0	1.567786	1.702571	0.768643	0.768643
Volatile Organic Compound	10	0.71255	0.76925	0.4292	0.4292
Volatile Organic Compound	20	0.55125	0.6101	0.28695	0.28695
Volatile Organic Compound	30	0.49535	0.5578	0.2164	0.2164
Volatile Organic Compound	40	0.4657	0.5307	0.178	0.178
Volatile Organic Compound	50	0.45225	0.50985	0.15955	0.15955
Volatile Organic Compound	60	0.4585	0.498625	0.1555	0.1555
Particulate	0	0.0116	0.0113	0.0381	0.0381
Particulate	10	0.0116	0.0113	0.0381	0.0381
Particulate	20	0.0116	0.0113	0.0381	0.0381
Particulate	30	0.0116	0.0113	0.0381	0.0381
Particulate	40	0.0116	0.0113	0.0381	0.0381
Particulate	50	0.0116	0.0113	0.0381	0.0381
Particulate	60	0.0116	0.0113	0.0381	0.0381

5.2.1.2 Costs

The PSRC Benefit-Cost tool uses traditional categorization to label measures as benefits and costs. Costs are limited to capital and operating costs associated with implementing the specific project. Other costs (such as change in user costs) are enumerated as benefits. Operating costs can be estimated using state and federal studies regarding pavement and bridge life (for example). Capital costs should rely on projected costs, and sensitivity analysis can be conducted to address the high degree of uncertainty in these estimates. Costs, like benefits, are adjusted to present value with discount rates. Discount rates are not provided and should be chosen as part of the fourth step of the benefit-cost analysis (Select economic factors).

5.2.2 FAA Airport Benefit-Cost Analysis Guidance

This tool is designed to allow the FAA to make considered evaluations of proposed airport projects under the Airport Improvement Program (AIP). This tool is required for discretionary projects (not ones necessary to meet various standards) requiring at least $5 million in AIP funding. The primary document provides guidance on producing a benefit-cost analysis for these projects and requires that all benefits and costs "affecting the aviation public or directly attributable to aviation" are included (*FAA 1999*, p. 3). However, sponsors of proposed projects are "encouraged to make use of innovative methods for quantifying benefits and costs where these methods can be shown to yield superior measures of project merit." (*FAA 1999*, p. 1)

Some proposed alternatives will induce demand which may affect costs or benefits. The FAA guidelines leave inclusion of the effects from induced demand up to the discretion of the project sponsor.

The steps of the process are as follows (*FAA 1999*, p. 6):

- "Define project objectives
- Specify assumptions about future airport conditions
- Identify the base case (no investment scenario)
- Identify and screen all reasonable alternatives to meet objectives
- Determine appropriate evaluation period
- Establish reasonable level of effort for analysis
- Identify, quantify, and evaluate benefits and costs of alternatives relative to base case
- Measure impact of alternatives on airport usage
- Compare benefits and costs of alternatives
- Evaluate variability of benefit-cost estimates
- Perform distributional assessment when warranted; and
- Make recommendation of best course of action"

The FAA guidelines clearly indicate a BCA is not just about the evaluation of costs and benefits, but relies on an appropriate framework for analysis. The first steps determine the objective(s) of the proposed projects and set standard future conditions within which all scenarios can be compared, as traffic growth will significantly affect the appropriate outcome. It considers reduced delay for aircraft, passengers and cargo; improved schedule predictability; more efficient traffic flows; use of larger, faster or more efficient aircraft; safety, security, and design standard benefits; environmental benefits; and operating and maintenance benefits. The process then requires identifying all appropriate alternatives and providing necessary bounds on the analysis, in terms of numbers of years to consider and the amount of detail appropriate. Only then does the process involve quantifying costs and benefits, bringing those to net present value, and conducting a sensitivity analysis for criteria with meaningful uncertainty. At that point, a recommendation can be made.

5.2.2.1 Benefits

Because the airport projects can impact three different areas: airside, terminal buildings, and landside), the FAA guide discusses the types of benefits that may accrue for each. Table 5.74 illustrates these associated benefits (*FAA 1999*, p. 27-27 Table 10.1 Benefits of Airport Projects).

Table 5.74: FAA Benefits (*FAA 1999*, p. 27-27 Table 10.1 Benefits of Airport Projects)

TABLE 10.1: BENEFITS OF AIRPORT PROJECTS

PROJECT TYPE	TYPICAL BENEFIT TYPE
AIRSIDE **Airside Capacity Projects**	
• New or extended runway, taxiway, apron, or hold pad	• Reduced aircraft, passenger, and cargo delay during normal airport operations • Reduced aircraft, passenger, and cargo delay during reconstruction of other airport facilities • Greater schedule predictability: - Aircraft operator able to make more efficient use of equipment and personnel - Passenger able to take later flight and arrive at destination on time • Improved efficiency of traffic flows (reduced vectoring and taxiing distances) • Reduced aircraft operating costs and passenger travel times due to airport's ability to accommodate faster, larger, and/or more efficient aircraft • Bringing pre-existing infrastructure into compliance with FAA safety and security standards • Safety improvements • Noise abatement • Reduction of aircraft emissions
• Reconstruction of runway, taxiway, apron, or hold pad	• Lower facility maintenance costs • Avoided loss of capacity benefits associated with facility failure
• Acquisition of airside equipment to support capacity objectives (navigational aids, snow removal and maintenance equipment)	• Reduced aircraft, passenger, and cargo delay during normal airport operations • Greater schedule predictability • Improved safety • Lower facility maintenance costs
Airside Safety, Security, and Design Standards Projects	
• Installation of signage and lighting • Expansion of runway safety areas • Removal of obstructions from existing approaches • Fencing • Acquisition of rescue and fire-fighting equipment	• Compliance with FAR and Advisory Circular safety, security, and design standards is mandatory and not subject to BCA. Compliance must be done in most cost-effective manner acceptable to FAA.
Airside Environmental Projects	
• Noise mitigation for pre-existing infrastructure (noise insulation, structure removal) • Fuel and chemical containment for pre-existing infrastructure	• Compliance with FAA environmental order is mandatory and not subject to BCA. Compliance must be done in most cost-effective manner acceptable to FAA.

AIRPORT TERMINAL BUILDING (ATB) **ATB Capacity Projects**	
• Reconstruction, expansion, and/or modernization of ATBs (excluding concession areas which are not eligible for AIP funding)	• Reduced aircraft, passenger, cargo, and meeter/greeter delay (attributable to more gates and faster passenger transfers to connecting flights) • Improved passenger schedule predictability (ability to allow less time for potential delays at ATB) • More efficient traffic flows (shortened pedestrian traffic distances) • Improved passenger comfort • Lower ATB operating and maintenance costs
• Baggage Handling Systems	• Reduced passenger and cargo delay • More efficient baggage distribution • Lower operating and maintenance costs
ATB Security Projects	
• Passenger, baggage, and freight security systems	• Compliance with FAA standards--not subject to BCA if primary objective of project
• Security fencing and gates	• Compliance with FAA standards--not subject to BCA if primary objective of project
Inter-Terminal Transportation	
• Fixed rail • Bus	• Reduced aircraft, passenger, and cargo delay (attributable to faster passenger transfers to connecting flights) • Improved passenger comfort • Lower operating and maintenance costs
LANDSIDE **Landside Access Projects**	
• Airport access roads • Passenger pick-up/drop-off areas • Transit areas	• Reduced passenger, cargo, and airport and airline employee delay in getting to airport • Improved schedule predictability (ability to leave later for airport and arrive on time for check in) • Lower operating and maintenance costs • Improved safety • Reduced automobile emissions

As illustrated in Table 5.74, reduced delay, improved safety, improved reliability, and lower operating costs are benefits that appear across project types. Each of the benefits identified is associated with measures, listed in Table 5.75. (*FAA 1999*, p. 34-35 Table 10.2 Measures of Airport Project Benefits)

Table 5.75: FAA Measures (*FAA 1999*, P. 34-35 Table 10.2 Measures of Airport Project Benefits)

TABLE 10.2: MEASURES OF AIRPORT PROJECT BENEFITS

BENEFIT TYPE	MEASUREMENT UNIT
Reduced Delay	
• Reduced aircraft delay	• Reduced aircraft delay hours by airborne, taxi, or gate status for each aircraft class (air carrier, commuter, GA, military)
• Reduced passenger delay	• Reduced passenger delay hours by airside, ATB, and landside status • Reduced passenger vehicle delay hours in landside access
• Reduced cargo delay	• Reduced units of express cargo arriving at/departing from airport after time required to make guaranteed delivery time • Reduced air freight ton delay hours by airside, ATB, and landside status • Reduced truck delay hours in landside access
Improved Schedule Predictability	
• Aircraft operator ability to make more efficient use of equipment and personnel due to more predictable schedules	• Reduced numbers of aircraft and crew required to accommodate posted schedules
• Passenger confidence to take later flight with expectation of arriving at destination on time • Passenger confidence to arrive at ATB closer to flight time with expectation of making flight • Passenger confidence to leave residence or business later for airport with expectation of arrival at ATB in time for check in	• Reduced hours of passenger travel time scheduled to accommodate potential delay by airside, ATB, and landside components (less the amount of reduced delay associated with the project)
More Efficient Traffic Flows	
• Reduced aircraft vectoring and taxiing	• Reduced aircraft and passenger hours due to more efficient layout of runways, taxiways, hold pads, and aprons
• Shortened pedestrian traffic distances	• Reduced passenger time required to walk or travel within ATB (not attributable to reduced ATB congestion)

Use of Larger, Faster and/or More Efficient Aircraft	
• Reduced aircraft operation costs and shorter passenger travel times due to service by larger, faster, and/or more efficient aircraft	• Lower cost/fare per revenue passenger mile • Lower cost/charge per revenue cargo ton mile • Reduced passenger hours associated with new direct flights • Reduced passenger hours associated with new jet flights • Reduced cargo ton hours associated with new direct flights
Safety, Security, and Design Standard Benefits Associated With Capacity Projects	
• New capacity project complies with FAA safety, security, and design standards	• No benefits applicable. All new capacity projects must be built to FAA safety, security, and design standards to qualify for AIP funds.
• New capacity project enables compliance of pre-existing infrastructure within FAA safety, security, and design standards	• Value of most cost-effective alternative means to bring pre-existing infrastructure into compliance with FAA safety, security, and design standards (if new project were not built)
• Increased safety associated with precision approaches	• Number of precision approaches flown with new landing system (will be calculated by FAA)
Environmental Benefits	
• New capacity project complies with Federal environmental requirements	• No benefits applicable. All new projects must be built to Federal environmental requirements
• New capacity project brings pre-existing infrastructure into compliance with Federal environmental requirements	• Value of most cost-effective alternative means to accommodate Federal environmental requirements (if new project were not built)
Airport Operating and Maintenance Benefits	
• Lower operating and maintenance costs	• Reduced employees, power, fuel, and maintenance materials per passenger

Airfield Delay Reductions should be evaluated using capacity simulation models. Airside delay analysis can be completed using airfield queuing models. FAA has three available: FAA Airport and Airspace Simulation Model (SIMMOD), the Airfield Delay Simulation Model (ADSIM), and the Runway Delay Simulation Model (RDSIM). Model input data can be gathered from the FAA's Enhanced Traffic Management System, weather data, air traffic controller data, and from airport records. Aircraft delay is converted to passenger and cargo delay based on load factors. Cargo load factors must be gathered from air cargo operators, and the relevant metric may be delay hours per cargo ton or numbers of cargo items too late for timely delivery.

Queuing models should also be used to evaluate terminal building delay reductions. As the FAA does not maintain terminal models, they suggest the Passenger Flow Simulation Model (Transport Canada) and the Airport Terminal Capacity Assessment Model (IATA) as options. Passenger volumes and non-passenger volumes (to be gathered from available data and surveys) by time of day are demand inputs.

Likewise, landside delay should also be evaluated using traffic simulation models. They suggest working with transportation planning departments for support in these calculations.

Measuring the value of Improved Schedule Predictability is challenging, as it relies on valuing delay accommodation, which can vary widely by stakeholder and condition. To this end, the amount of extra time incorporated to account for uncertainty by various entities should be gathered through surveys.

The benefits from More Efficient Airside Traffic Flows can be gathered from the simulation modeling done to measure delay gains. These benefits are measured in terms of aircraft operating hours reductions or pedestrian walking time.

Measuring the benefits from Larger, Faster, and More Efficient Aircraft is complex because of interwoven set of results including different routes and aircraft mixes. The FAA suggests using comparable airports, interview with air carriers, and surveys of passengers to estimate the impacts to cost and fare structure as well as the resulting reduced transit time. Cost reductions provided by carriers should be used when available and well-documented.

While projects at airports designed to meet various standards are not eligible for AIP funding, projects primarily undertaken for other purposes can still yield safety, security, environmental and design standard benefits. Environmental impacts should be evaluated within the context of air (Emissions and Dispersion Modeling System) and noise (Integrated Noise Model) models. These benefits can be assessed by the cost saving from avoiding the lowest-cost alternative solution, by the value of time saved, or by the value of avoided fatalities, injuries, and property damage (available in FAA/APO bulletins).

Lowered Operations and Maintenance costs are often seen as benefits but should be assessed as a cost within the FAA BCA. Likewise, economic values from increased employment, income or productivity gains are hard to quantify and are not improvements to the airway system. While they are relevant, they should be included separately and not within the BCA.

5.2.2.2 Costs

Costs should include all capital, labor, and natural resources required to support a project regardless of the payer. The FAA supports using lifecycle costs including Planning, Research and Development Costs; Investment Costs; Operations and Maintenance Costs; and Termination Costs. Planning costs should include all design, permitting, planning and outreach costs but should not include costs associated with producing the BCA (despite the fact that the FAA indicates BCAs may have costs in the multimillion dollar range for complicated projects). Investment costs should include land interests; construction costs (labor, materials, transportation, contingency, professional service fee, administrative costs); necessary equipment, parts, and furniture; training costs; and transition costs. Operations and Maintenance costs are recurring costs including personnel costs,

materials, utilities, and travel and transportation. Termination Costs include dismantling and site restoration costs less potential salvage value.

5.2.2.3 Values

The values of the measures should be converted to economic (dollar) values and should be reported in analysis year dollars, with a 7 percent discount rate. The value of each component should be the same for incremental and fractional units. Table 5.76 summarizes the method of valuing a particular benefit measure as well as the source for the value data. (*FAA 1999*, p. 52-54)

The various time components mentioned as benefits can be converted to dollar values by considering the value of time each stakeholder has (aircraft, passengers, cargo, and passenger meter/greeters). Aircraft value is in terms of variable operating costs (crew costs, maintenance and fuel and oil consumed) and will vary upon the location of the time savings (in flight, taxiing or at the gate). Generally, fixed costs should not be included unless the gains are clearly large enough to justify elimination of additional aircraft. Willingness-to-pay to avoid travel delay should be used to value passenger time and may be differentiated based on business or non-business passengers. FHWA should be used as a source for operating costs for reduced vehicle hours. FAA does not have a preferred method for valuing time savings for air cargo. They allow for a number of methods including using a factored value of a ton of air cargo, additional costs for perishable goods, and higher transportation costs needed to expedite late packages. These values should be obtained from operators. The FAA suggests meeter/greeters are not necessary components in travel but do have personal time values. As such, the FAA suggests valuing meeter/greeter time at half the value of the associated passenger.

Table 5.76: FAA Valuation (*FAA 1999*, p. 52-54)

TABLE 10.4: VALUATION OF AIRPORT PROJECT BENEFITS

BENEFIT UNIT	VALUATION	SOURCE OF VALUE DATA
Reduced Aircraft Delay Hours		
• Reduced aircraft delay hours by airborne, taxi, or gate status for each aircraft class (air carrier, commuter, GA, military)	Operating cost per aircraft hour, adjusted for aircraft class and delay location status. In limited cases, saved aircraft capital cost may be considered.	Documented operating cost data (net of depreciation) provided by aircraft operators (if available). Consult FAA-APO-98-8for aircraft type or class values by block hour. Where aircraft fleet size can be reduced due to large delay savings, use published used aircraft values (see FAA-APO-98-8). FAA-APO-98-8 also contains current lease values.
Reduced Passenger Delay Hours		
• Reduced business and non-business passenger delay hours by airside, ATB, and landside status	Passenger willingness to pay to avoid one hour of travel delay	FAA-APO-98-8 contains the passenger travel time values which OST has developed and requires FAA to use.
• Reduced passenger vehicle hours in landside access	Passenger vehicle operating costs	Current FHWA estimates.
Reduced Air Cargo Delay Hours		
• Reduced air cargo ton hours by airside, ATB, and landside status	Opportunity cost of cargo delayed in transit/Spoilage of time sensitive cargo	Documented data on value of cargo provided by operators (if available). Apply 7 percent real opportunity cost (annual basis) to value of cargo for period delayed.
• Units of express cargo arriving late at airport after time required to make guaranteed delivery time	Refunded shipping revenue for late package delivery or greater resource costs expended to compensate for airport delays	Documented data provided by operators.
• Reduced trucking hours in landside access	Cargo vehicle operating costs	Current FHWA estimates for light trucks (including driver costs).
Reduced Meeter/Greeter Delay Hours		
• Reduced meeter/greeter delay hours by airside, ATB, and landside status	Meeter/greeter willingness to pay to avoid one hour of delay	FAA has not assigned a value to meeter/greeter time. Sensitivity analysis should assume half the values applied to passenger time in FAA-APO-98-8.

BENEFIT UNIT	VALUATION	SOURCE OF VALUE DATA
Improved Schedule Predictability		
Reduced Aircraft Delay Hours		
• Reduced resources needed to meet flight schedules	Cost of resources allocated to accommodate potential delays	Documented cost data provided by operators (if available).
• Reduced hours of passenger travel time scheduled to accommodate potential delay, less reduced actual delay, by airside, ATB, and landside status	Passenger willingness to pay to avoid one hour of scheduled travel time	Use passenger travel time values in FAA-APO-98-8.
More Efficient Traffic Flows		
• Reduced aircraft hours in airspace and on ground due to more efficient layout of runways, taxiways, and aprons	Operating cost per aircraft hour, adjusted for aircraft class and airborne, taxi, or gate status (if available).	See Reduced Aircraft Delay
• Reduced passenger hours due to more efficient airside, ATB, and landside traffic flows	Passenger willingness to pay to avoid one hour of scheduled travel time	See Improved Schedule Predictability/Reduced Hours of Scheduled Passenger Time
Use of Larger, Faster and/or More Efficient Aircraft		
• Lower cost due to more efficient aircraft	Cost or fare reduction per passenger/cargo unit	Information provided by aircraft operators (if available). Commercially available data on average yield, destinations, and trip distance at subject and comparison airports.
• Reduced passenger hours on direct flights or jet flights	Passenger willingness to pay to avoid scheduled travel hour	See Improved Schedule Predictability/Reduced Hours of Scheduled Passenger Time for valuation of reduced trip hours.
• Reduced cargo hours on direct or jet flights	Opportunity cost of cargo in transit/Reduction in resources to meet guaranteed delivery times	See Reduced Air Cargo Delay
Safety, Security, and Design Standard Benefits Associated With Capacity Projects		
• Accommodation of safety, security, and design standards of pre-existing airport infrastructure	Lowest-cost alternative means to achieve compliance of pre-existing infrastructure with FAA standards	Engineering cost estimates of alternative project designed specifically to correct sub-standard conditions. Compare to delay cost imposed by an operating restriction to accomplish same objective.

BENEFIT UNIT	VALUATION	SOURCE OF VALUE DATA
Safety Benefits of Capacity Projects		
• Precision approaches enabled by new landing system	Reduced fatalities, injuries, and property damage per precision approach	Benefits calculated by FAA.
Environmental Benefits of Capacity Projects		
• Accommodation of environmental standards for pre-existing airport operations	Lowest-cost alternative means to attain compliance with standards	Engineering cost estimates of project designed specifically to correct sub-standard environmental compliance. Compare to delay cost imposed by an operating restriction to accomplish same objective.
Airport Operating and Maintenance Benefits		
• Reduced employee, power, fuel, and maintenance per passenger	Cost reduction in personnel, energy, and supplies. To be treated as cost element (see Section 11).	Airport accounting records and management cost estimates.

Ultimately, the analysis is completed by considering the Net Present Value (*FAA 1999*, p. 79) or Benefit-cost ratio (*FAA 1999*, p. 81), and the alternative with the largest positive Net Present Value is given primary consideration.

5.2.3 TIGER Grants

As with the other methods, completing a BCA for TIGER Discretionary Grant applications requires appropriate contextualization. The baseline assumption (base or no build) should be the expected condition if the project does not receive TIGER Discretionary Grant funding. This may involve existing conditions or may include projected changes. Reasonable alternatives, including smaller-scale projects, should be included, and applicants should include the number of passengers (in passenger-miles) or amount of freight affected (in ton-miles or value).

5.2.3.1 Benefits

Applicants should estimate all project benefits that adhere to the five long-term outcomes or criteria (livability, economic competitiveness, safety, state of good repair, and environmental sustainability). Benefits may support more than one of these criteria but should only be included once in the evaluation. The guidance document outlines most but not all primary benefit categories in Table 5.77 (*USDOT 2013a*, p. 6-7).

Table 5.77: TIGER Grant Benefit Categories (*USDOT 2013a*, p. 6-7)

Long-term Outcome	Types of Societal Benefits
Livability	Land Use Changes the Reduce VMT
	Increased Accessibility
	Property Value Increases
Economic Competitiveness	Travel Time Savings
	Operating Cost Savings
Safety	Prevented Accidents (Property Damage), Injuries, and Fatalities
State of Good Repair	Deferral of Complete Replacement
	Maintenance & Repair Savings
	Reduced VMT from Not Closing Bridges
Environmental Sustainability	Environmental Benefits from Reduced Emissions

Benefits should address the extent to which "residents of the United States as a whole are made better off." (*USDOT 2013a*, p. 1) and all included benefits should be clearly and directly tied to the funded project. Likewise, all costs associated with the funded project, not just the TIGER Discretionary Grant funds, should be included to ensure all costs and benefits of a particular project are represented. Finally, once identified, all costs and benefits should be discounted to present values. The current prevailing government discount rate of 7 percent should be used, but a discount rate of 3 percent may also be included for comparison.

5.2.3.2 Values

Travel time savings solely from the funded project should be identified, sensitive to changes over time. The DOT's value of time should be applied to the travel time savings by traveler category: business and non-business travelers. The values of time suggested by USDOT (*USDOT 2013b*, p. 5) are included below in Table 5.78.

Table 5.78: TIGER Grant Suggested Values of Time (*USDOT 2013b*, p. 5)

Recommended Hourly Values of Travel Time Savings (2009 U.S. $ per person-hour)		
Category	**Surface Modes* (except High-Speed Rail)**	**Air and High-Speed Rail Travel**
Local Travel		
Personal	$12.00	
Business	$22.90	
All Purposes **	$12.50	
Intercity Travel		
Personal	$16.70	$31.90
Business	$22.90	$57.20
All Purposes **	$18.00	$42.10
Truck Drivers	$24.70	
Bus Drivers	$24.50	
Transit Rail Operators	$40.40	
Locomotive Engineers	$34.30	
Airline Pilots and Engineers	$76.10	

* Surface figures apply to all combinations of in-vehicle and other transit time. Walk access, waiting, and transfer time in personal travel should be valued at $23.90 per hour for personal travel when actions affect only those elements of travel time.

** These are weighted averages, using distributions of travel by trip purpose on various modes. Distribution for local travel by surface modes: 95.4% personal, 4.6% business. Distribution for intercity travel by conventional surface modes: 78.6% personal, 21.4% business. Distribution for intercity travel by air or high-speed rail: 59.6% personal, 40.4% business. Surface figures derived using annual person-miles of travel (PMT) data from the 2001 National Household Travel Survey. http://nhts.ornl.gov/. Air figures use person-trip data.

Operating cost savings should be identified for freight- and passenger-related projects and can be counted for any recipient of the savings, but should only be counted once. If a carrier reduces operating costs and that reduction is included, the savings passed from the carrier to the shipper should not also be included. Operating cost savings may include fuel savings, lower-cost alternative modes, and reduced operating costs of vehicles.

Emissions reductions from criteria pollutants and greenhouse gases associated with reduced congestion, idling, and vehicle-miles travelled and use of less-polluting modes should be included and converted to dollar values. Monetized values per ton are included below in Table 5.79(*USDOT 2013*b, p. 6-7).

Table 5.79: TIGER Grant Monetization Rates for Emissions (*USDOT 2013b*, p. 6-7)

Emission Type	$ / short ton ($2010)	$ / metric ton ($2010)
Carbon dioxide (CO_2)	(varies)*	(varies)*
Volatile Organic Compounds (VOCs)	$1,700	$1,874
Nitrogen oxides (NOx)	$6,700	$7,385
Particulate matter (PM)	$306,500	$337,858
Sulfur dioxide (SOx)	$39,600	$43,651

* See **"Social Cost of Carbon (3%)"** values below.

Year	3% SCC (2007$)
2010	21.40
2011	21.90
2012	22.40
2013	22.80
2014	23.30
2015	23.80
2016	24.30
2017	24.80
2018	25.30
2019	25.80
2020	26.30
2021	27.00
2022	27.60
2023	28.30
2024	28.90
2025	29.60
2026	30.20
2027	30.90
2028	31.50
2029	32.10
2030	32.80

Year	3% SCC (2007$)
2031	33.40
2032	34.10
2033	34.70
2034	35.40
2035	36.00
2036	36.70
2037	37.30
2038	37.90
2039	38.60
2040	39.20
2041	39.80
2042	40.40
2043	40.90
2044	41.50
2045	42.10
2046	42.60
2047	43.20
2048	43.80
2049	44.40
2050	44.90

Reduced long-term maintenance and repair costs should be included as part of life-cycle costs of projects.

Safety costs should be estimated using crash causation factors or other justifiable method to illustrate an anticipated reduction in crash rates, and USDOT value of life and injury figures to convert the rates to dollar values. A value of a statistical life of $9,100,000 is suggested per fatality, and property damage only crashes are valued at $3,206 per vehicle

(presumably highway only). Injury values are related to injury severity and based on the fatality values. These are summarized in Table 5.80 (all values from *USDOT 2013b*, p. 2-4 Table 1).

Table 5.80: TIGER Grant Injury Values (all values from *USDOT 2013b*, p. 2-4 Table 1)

AIS Level	Severity	Fraction of VSL	Unit value ($2012)
AIS 1	Minor	0.003	$ 27,300
AIS 2	Moderate	0.047	$ 427,700
AIS 3	Serious	0.105	$ 955,500
AIS 4	Severe	0.266	$ 2,420,600
AIS 5	Critical	0.593	$ 5,396,300
AIS 6	Unsurvivable	1.000	$ 9,100,000

Property value increases should only be included if they truly represent an increase over what would be expected, should not include increase in value from developer's investment, and should not include increases in value that result from a corresponding decrease elsewhere. Claims of property value increases must be thoroughly supported and can only be included as one-time gains, not annual benefits.

Other potential benefit sources such as transit and bicycle paths or land use changes should first account for benefits that have been discussed above (such as travel time savings, reduced congestion, reduced operating costs and reduced emissions) before accounting for any other benefits. They do not provide a methodology for conducting these evaluations – they require the applicant to provide a defensible methodology.

TIGER guidance prohibits including any transfers when accounting for benefits, which includes wages and taxes. Increased productivity is an acceptable benefit to include.

5.2.4 WSDOT Freight Rail Benefit Cost

The WSDOT Freight Rail Benefit-cost analysis should be applied to all WSDOT freight rail projects, including Freight Rail Assistance Program and Freight Rail Investment Bank Program projects. The standard methodology may be supplemented with additional benefit information but these changes must be justified with adequate documentation. WSDOT completes the benefit-cost analysis based on information provided by the applicant and covers the primary criteria of Transportation and Economic Benefits, Economic Impacts, External Impacts, and Total Maintenance Costs. These benefit criteria are associated with specific measures. Table 5.81 illustrates an example completed benefit-cost analysis calculator spreadsheet for a Freight Rail Investment Bank project (*WSDOT 2008*, p. 213).

Table 5.81: WSDOT Freight Rail Example Benefit Cost Analysis (*WSDOT 2008*, p. 213)

This Benefit/Cost spreadsheet is used to calculate cost-effectiveness of rail projects based on the initial construction cost of the project and anticipated yearly savings and maintenance costs. Enter benefits starting in the year they will start to be realized.

	2008	2009	2010	2011	2012	2013	2014	
Measures (see measures sheet for explanations)								
Transportation and Economic Benefits								
Reduced Road Maintenance Costs					$4,147	$5,076	$6,048	
Shipper Savings					$49,075	$60,066	$71,568	
Reduction in auto delays at grade crossing								
Economic Impacts								
New or retained jobs								
Tax from industrial development								
External Impacts								
Safety Improvements					$48,425	$59,271	$70,620	
Environmental benefits					$45,824	$56,087	$66,827	
Total Maint Costs	**Yearly maintenance and other recurring costs**							
$65,933	$0	$0	$0	$0	$6,500	$7,000	$7,500	
Maint Present Value	$0	$0	$0	$0	$5,343	$5,532	$5,699	
Project Cost	**Net Yearly Benefits**							
$1,291,354	$0	$0	$0	$0	$147,471	$180,500	$215,063	
Benefit Present Value	$0	$0	$0	$0	$121,210	$142,652	$163,430	

Factor	Value		Definition
15 -Yr. Benefits	$3,034,694		Total Benefits
Payback*	10.23	years	Time for payback
Discount Rate	4.00%		Rate used to calculate time value of money
NPV	$654,244		Net Present Value of all costs and benefits
B/C Ratio	1.48		The ratio of the Net Present Value of all benefits to Net Preser
B/C Pass	yes		B/C ratio greater than or equal to 1.00?

Screen shot of Benefit/Cost Analysis Calculator used on a Rail Bank Project Application

5.2.4.1 Benefits

The benefits identified in the BCA tool are Transportation and Economic Benefits, Economic Impacts, External Impacts, and Yearly Maintenance Costs. These benefits are measured according to Table 5.82 (*WSDOT 2008*, p. 213-214).

Table 5.82: WSDOT Freight Rail Benefits Measures (*WSDOT 2008*, p. 213-214)

Transportation and Economic Benefits	Reduced maintenance costs	If the project preserves rail service, the no-action alternative may put more freight traffic on highways. This may produce a net positive or negative benefit to be evaluated based on the type of road affected and the cost of maintaining the rail line.
	Reduction in shipper costs (for shipments originating in State) – freight only	Benefits derived are from lower logistic costs to the shippers, which ultimately can lead to lower consumer prices. This can include the ability to use different modes that provide competitive alternatives for shippers.
	Reduction in automobile delays at grade crossings	Benefits that would be realized by reducing automobile delays at grade crossings.
Economic impacts	New or retained jobs	Jobs that a particular project/action may keep from moving out of the State (e.g. by construction of a rail spu serving a factory or warehouse, etc.), or new jobs that are created within the state. Also to be considered are changes in job quality and production.
	Tax increases from industrial development	A rail action/project may foster industrial development that results in increased industrial property taxes to the state.
External Impacts	Safety improvements	By diverting truck freight to rail, savings on highway safety improvements may occur as well as adding fencing, removing a crossing, etc.
	Environmental benefits	Railroads are on average three or more times more fuel efficient than trucks. The state can benefit from savings due to environmental improvements. This includes air and water quality as well as reduction of the use of petroleum, consistent with the Governor's policies.
Yearly maintenance costs	Track maintenance	Costs for maintaining a track or section of track that is part of a project.
	Equipment maintenance	Equipment maintenance costs for equipment that is purchased as part of the project.

5.2.4.2 Costs

The application asks the applicant to fill in the following table (Table 5.83) to identify costs and requires an estimate of project cost reviewed and signed by a licensed P.E. to be submitted (*WSDOT 2008*, p. 181).

Table 5.83: WSDOT Freight Rail Cost Matrix (*WSDOT 2008*, p. 181)

	Design Engineering	Right of Way	Construction Engineering	Construction Other	Construction Contract	Total
Estimated Project Cost						
Committed Local Funds						
Additional Local Funds Requested						
Other Committed Funds						
WSDOT Funds Requested						

5.2.4.3 Values

The application asks the applicant to provide the information listed in Table 5.84 to calculate benefits (*WSDOT 2008*, p. 182-184 & 198-200).

Table 5.84: WSDOT Freight Rail Valuation (*WSDOT 2008*, p. 182-184 & 198-200)

Transportation and Economic Benefits	Reduced maintenance costs	• Maintenance costs may include but are not limited to vegetation clearing, ballast renewal, and tie replacement.
	Reduced road impacts	• Total length of truck mileage per one-way trip that will move to rail as a result of the project. • Type of trucks (e.g. semi, parcel, wide or oversize load) • Types of products that are being transported (e.g. grain, steel, lumber, computers). • Provide the number of rail cars shipped on the project-impacted segment of the railroad line in years 2002-2007. Provide type/weight of rail cars, if known. • Provide an estimate of the total number of rail cars that will be shipped over the affected rail line segment for years 2009 - 2014 if the project is built. • How much of that additional rail traffic is currently transported by trucks? What route do those trucks follow? Please give route names and mileposts. • How many rail cars will be diverted to truck transport if the project is not completed? What route will those trucks follow? Please give route names and mileposts.

	Reduction in shipper costs (for shipments originating in State) – freight only	• Difference in cost of shipping by rail (e.g. Truck Rate vs. Rail Rate – this may vary depending on commodity, location, destination, etc. give supporting information) • Improvements in reliability of service • Improvement to rail access • Provide a list of shippers that use the rail line or rail-related facility today, and the number of rail carloads shipped by each shipper using that segment in 2007. • Provide a list of shippers that will use the rail line if the project is completed, and the estimated total number of rail cars each will ship. • Include a contact person's name, title, company name, email address and phone number for each current and prospective shipper.
	Reducing system-wide rail delays	• Please explain how the proposal will eliminate or reduce overall rail system delays. Examples of delay reduction: • Realignment of rail track to increase speeds on the main line or at junctions. • Provision of a longer run-around loop to avoid a train having to be split to be run-around. • Lengthen sidings to enable a facility to receive longer trains and avoid the end of the train standing foul of the main line until removed by a switching locomotive.
	Reduction in automobile delays at grade crossings	• At-grade crossing location • Traffic information for trains and automobiles • Average Annual Daily Traffic for each at-grade crossing • The average time that trains block each at-grade crossing • Narrative on how the project will result in the elimination or reduction in delays
Economic impacts	New or retained jobs	• Number of full time direct jobs created • Number of full time jobs retained • Hourly wage for all new jobs • Hourly wage for all retained jobs • What is the current payroll of jobs that will be preserved by completing this project? What is the projected payroll of jobs that would be created, both on the railroad and in the industries it would serve? • For each group of jobs that will be sustained or created, please provide the name of a contact person, the company's name, and a phone number; see shippers list.

	Tax increases from industrial development	• Type of industrial development • Assessed value of the industrial development
	Geographic balance and support for regional economies	• Is the project in a county listed as economically distressed by the Washington State Department of Community, Trade and Economic Development (CTED)? If the project is not in one of the listed counties, but the rail line on which the project is located runs through one of them, detail any positive economic benefits that would accrue to the distressed county.
External Impacts	Safety improvements	• The estimated annual amounts of freight tonnage that will use rail as a direct result of the project. • Specific information on property damage that may be reduced or eliminated. • Specific information on injury accidents that may be reduced or eliminated.
	Environmental benefits	• The estimated annual truck trips reduced by using rail as a direct result of the project.
Yearly maintenance costs	Track maintenance	• Provide the estimated costs for maintenance for the project starting in the year they will be realized. Maintenance costs may include but are not limited to vegetation clearing, ballast renewal, and tie replacement.
	Equipment maintenance	

5.2.5 Summary: Evaluation of Tools and Their Utility across Modes for Benefit-Cost Methodologies

The benefit-cost analysis tools discussed above all follow the same general methodology:

1. Identify the motivation for the project
2. Identify an appropriate base case
3. Consider adequate and relevant alternatives
4. Quantify benefits and costs
5. Discount to present value
6. Compare benefits to costs to identify acceptable or optimal alternatives

The metrics the tools utilize were categorized using the researchers' judgment to identify themes. As illustrated in Table 5.85, quite a number of the criteria are standard across methods and modes. For example, all consider safety improvements, reduced operating and maintenance costs, and reduction in environmental impacts. However, the measures associated with these

categories are difficult to standardize across modes. For example, the WSDOT Freight Rail Benefit-Cost tool puts significant emphasis on converting truck travel to rail travel and does not consider the absolute emissions produced, but the difference in emissions between truck travel and rail travel. The FAA benefit-cost tool does not consider emissions in its environmental assessment but grants benefit value to projects that increase adherence to various Federal environmental standards. That being said, emissions could be estimated for most of the modes.

While there are critical differences in the methods, most have to do with the beneficiary of the improvements. As long as benefits to all potential beneficiaries are included (but not double counted), this challenge is not insurmountable.

The way the BC tools outlined above are described, they allow for considerable flexibility in implementation. They have a set of critical criteria and require monetization of the measures for those criteria, but are generally vague in the specific calculations of the measures. The PSRC tool is the lone exception, in that it relies directly on their travel demand model, which is primarily highway-based. It does include on some level transit, walk and bike trips, but does not address non-highway freight modes.

These tools are consistent in the way the measures are monetized, providing clear guidance for the value of a fatality or the value of time that should be used. These valuations generally can readily be applied across modes.

Table 5.85: Overall Categories of Benefits Considered by the Examined Benefit-Cost Tools

location	Washington	Puget Sound (WA region)	FAA	TIGER Grants
tool	State Rail Benefit-Cost	Benefit Cost	Benefit Cost	Benefit Cost
mode	Rail	Highway	Air	All
General mobility/ congestion relief, may include freight-specific measures	value of motorist time (usually function of average wages) multiplied by expected reduction in delay	travel time savings, reliability savings	reduced delay (aircraft, passenger, cargo), Improved schedule predictability	travel time savings
Safety and security	estimated money saved by not having to make highway safety improvements	accident cost savings	improved safety	prevented accidents
Environmental stewardship	total distance traveled by trucks diverted to rail multiplied by a standard environmental cost per mile	emissions costs	environmental standard adherence	reduced emissions
System preservation/ addressing deficient conditions/ maintenance	reduce maintenance costs, track maintenance, equipment maintenance	facility operating costs	airport operating and maintenance costs	maintenance & repair savings, deferral of complete replacement
Economics & competitiveness	estimated assessed property value after project multiplied by property tax rate			
Land use and development plans				land use changes that reduce VMT, increased accessibility, property value increases
Connectivity for freight mobility				
Reduces transportation costs	comparison of cost of shipping goods via rail versus truck	vehicle operating and ownership cost savings	lower operating costs and capital costs	operating cost savings
Freight-specific mobility				
New or retained jobs	average wages for the region from Bureau of Labor statistics multiplied by an economic multiplier to gauge total impacts			

The biggest source of variation across modes is in how the underlying measure is calculated. For example, once the amount of delay is developed, converting that value to a dollar equivalent is relatively straightforward and modal differences do not appear to pose challenges. The biggest obstacle is developing a consistent way to estimate change in delay for projects across modes. For example, an intersection project may measure change in delay in seconds or minutes, while a freight rail project may not have such a fine-grained measurement potential. Further, the types of criteria that are generally used (changes to safety, congestion or delay, economic impacts, or environmental impacts) are much better studied for highway projects than for other modes. More tools exist and these tools are based on a longer and richer research foundation for road-based projects than for other modes. In addition, a much more extensive data set is generally available for roadway projects. Also, for roadway projects, freight projects can leverage the knowledge developed for passenger travel. For other modes, including freight rail, air and water movements, the modes themselves have been studied less and the freight impacts are notably different.

The benefit that will be hardest to standardize across modes is the consideration of the value of delay. Different modes have different scales of delay that matter related to the type of freight being moved. Perishable or express freight has a much different cost of delay than bulk commodities or ocean shipping might. The FAA method of including one of two costs depending on the type of freight – express or other – might be a way to address this concern.

In the end, the benefit-cost tools are generally reliant on what is quantifiable, and therefore are more readily compared across modes. However, they do require developing acceptable methods of evaluating the foundational measures for each mode. The DOT would need to establish reasonably comparable methods for estimating number of reduced fatalities or time travel savings for each mode. Some modes have well-established methods for some of these (highway projects are particularly well-studied, for example, and some delay models exist for air travel), but others may require new or modified tools.

While the general outline of the BCA methodology lends itself to comparison across modes, it does not necessary serve projects in which modal shifts occur. For those projects, methods of estimating the amount of shifted traffic are needed to feed the larger travel estimation tools and these methods, based on our survey, appear to be underdeveloped. Further, for project emphasizing modal shifts, evaluations must be vigilant against double counting benefits.

The methods reviewed indicate no obvious bias toward under- or over-estimating costs or emissions. Highway evaluations generally rely on a longer history and larger set of data. The lack of data or models available for other modes implies more uncertainty in their values, as opposed to a clear bias. As has been mentioned, tools that assume increases in non-highway travel are directly shifted from highway travel are likely to be overestimating the impacts. The Washington Freight Rail assessment takes a more nuanced approach to measuring this shift, considering the differences between highway and rail trip making patterns.

6.0 SUMMARY AND RECOMMENDATIONS

This report reviews methods currently used by select department of transportation (DOTs) nationwide and summarizes the existing academic literature on the state of the science for incorporating freight into project prioritization. It then identifies nine methods for in-depth review and evaluates the limitations of the available methods. Finally, a set of suggestions for developing a multi-modal freight project prioritization methodology is presented.

Both the academic literature and DOT resources were reviewed to gather information regarding the state of practice and science in regards to multimodal (or single mode) freight project prioritization. All state DOT websites were reviewed as well as select regional ones. The DOT state websites were searched for terms including *freight plans*, *long range plans*, *multimodal plans*, *investment* and *project prioritization*. The search did find some scorecard methods used or proposed for use as multimodal prioritization tools, although most were not devoted totally to freight. The academic literature was examined for terms including *economic impact analysis*, *project prioritization*, and *benefit estimation*. The search did not identify implemented or proposed multimodal freight prioritization tools. Therefore, case studies for different modes were included for review. Most of the cases relied on either a scorecard framework or a benefit-cost framework.

After reviewing the literature, nine cases were chosen for detailed review, as they had an adequate amount of methodological detail available and covered a range of modes and scales. These tools also all appear to have a freight component and also are the most developed in terms of having details on criteria, performance measures, scoring and weights. The nine cases are:

- Maryland DOT Scorecard
- Ohio DOT Scorecard
- Puget Sound Regional Council Transportation Projects Scorecard
- Florida DOT Rail and General Highway Scorecards
- Missouri DOT Long Range Transportation Plan
- TIGER Grants Benefit-Cost Analysis
- Federal Aviation Authority Cost Benefit Analysis Guide
- Washington State Department of Transportation Truck Freight Highway Benefit-Cost Methodology
- Puget Sound Regional Council Benefit-Cost Analysis

Table 6.1 and Table 6.2 summarize the measures and metrics used by the scorecard and benefit-cost tools, respectively.

Table 6.1: Overall Categories of Benefits Considered by the Examined Scorecard Tools

location	Florida	Maryland	Missouri	Ohio	Puget Sound (WA region)
tool	SIS Investment Tool	Freight Evaluation Criteria	Function Needs Prioritization Process	TRAC Scorecard	Scorecard
mode	Highway	Highway, Rail	Road, Bridge (waterway)	Road, Bridge, (all)	Highway
General mobility/ congestion relief, may include freight-specific measures	connector location, v/c ratio, truck volume, vehicular volume, system gap, change in v/c-LOS or Interchange operations, bottleneck/grade separation, delay	AADT,v/c ratio	LOS, daily usage, functional classification	v/c ratio, ADTT, peak hour ridership/capacity, VMT reduction	travel
Safety and security	crash ratio, fatal crash, bridge appraisal rating, link to military base	crash rate, development of inspection/weigh station	safety index, safety concern, safety enhancements	crash density/frequency, severity, crash ratio	safety and system security
Environmental stewardship	land and social criteria, geology criteria, habitat criteria, water criteria		environmental index	air quality, emissions reduction	air quality, Puget Sound land & water
System preservation/ addressing deficient conditions/ maintenance	v/c ratio, truck volume, vehicular volume, bridge condition rating		substandard roadway or bridge features, pavement smoothness, pavement condition, functional classification, daily usage (all vehicles), truck usage, bridge condition, exceptional bridge	functional class	
Economics & competitiveness	demographic preparedness, private sector robustness, tourism intensity, supporting facilities		level of economic distress, supports regional economic development plans	economic impact, considering factors of economic distress, adopting appropriate land use measure, positioning land for redevelopment	
Land use and development plans		reinforce the development of freight-related land uses within existing freight activity centers or direct new development to PFAs and sites with adequate infrastructure	connectivity, complies with regional or local transportation plans		support for centers
Connectivity for freight mobility		enhance connectivity between freight modes and/or improve access to clusters of freight-intensive industries	connectivity, complies with regional or local transportation plans	intermodal connectivity	multi-modal
Reduces transportation costs					
Freight-specific mobility			truck volume, freight bottlenecks, intermodal freight connectivity	intermodal connectivity, AADT, v/c ratio	freight
New or retained jobs					jobs
Miscellaneous	land and social criteria, geology criteria, habitat criteria, water criteria	coordination: to fulfill the plans, programs, or goals of multiple agencies	access to opportunity: Vehicle Ownership, eliminate bike/ped barriers		

Table 6.2: Overall Categories of Benefits Considered by the Examined Benefit-Cost Tools

location	Washington	Puget Sound (WA region)	FAA	TIGER Grants
tool	State Rail Benefit-Cost	Benefit Cost	Benefit Cost	Benefit Cost
mode	Rail	Highway	Air	All
General mobility/ congestion relief, may include freight-specific measures	value of motorist time (usually function of average wages) multiplied by expected reduction in delay	travel time savings, reliability savings	reduced delay (aircraft, passenger, cargo), Improved schedule predictability	travel time savings
Safety and security	estimated money saved by not having to make highway safety improvements	accident cost savings	improved safety	prevented accidents
Environmental stewardship	total distance traveled by trucks diverted to rail multiplied by a standard environmental cost per mile	emissions costs	environmental standard adherence	reduced emissions
System preservation/ addressing deficient conditions/ maintenance	reduce maintenance costs, track maintenance, equipment maintenance	facility operating costs	airport operating and maintenance costs	maintenance & repair savings, deferral of complete replacement
Economics & competitiveness	estimated assessed property value after project multiplied by property tax rate			
Land use and development plans				land use changes that reduce VMT, increased accessibility, property value increases
Connectivity for freight mobility				
Reduces transportation costs	comparison of cost of shipping goods via rail versus truck	vehicle operating and ownership cost savings	lower operating costs and capital costs	operating cost savings
Freight-specific mobility				
New or retained jobs	average wages for the region from Bureau of Labor statistics multiplied by an economic multiplier to gauge total impacts			

As illustrated in the tables, the following measures were used by more than half of the tools:

- Mobility
- Safety and Security
- Economic Impact
- Environmental Stewardship
- Connectivity (esp. for Freight Mobility)
- Land Use & Development Patterns

While the frequent use of these types of measures is an indication of their perceived importance, the ability to or availability of data to support these measures varies considerably. Data has been gathered regularly to support some metrics for Mobility and Safety (volumes, crash data). Aspects of those two measures (reliability, for example) as well as most others are challenging to define and difficult to gather data to support. The measures are consistent across modes and do not pose barriers toward multimodal comparison. Identifying appropriate metrics and valuations is the area requiring attention.

Benefit-cost tools convert all metrics to monetary value. This conversion is useful for multimodal comparison, because it ultimately creates one universal measure. However, ensuring monetary values are consistent across modes is not straightforward, especially in freight. Different modes, users, and commodities have different values and values of time. Maintaining information for all commodities is too ambitious at this time. A small number of categories may be able to provide meaningful increases in the accuracy of valuation. At the very least, treating general cargo differently than time-critical parcels is a good first step. Pursuing surveys of carriers to establish value of time across commodities is advisable. Further, some of the metrics have more evidence supporting their associated monetary values (for example, value of time is reasonably well-studied), while others are still being established (for example carbon costs). In addition, DOTs frequently monetize safety but these values still have considerable variation. The PSRC benefit-cost tool values a fatality at $2,500,000, while the TIGER tools values a fatality at $9,100,000. Generally, the values of time, values for carbon, and values for safety have the same order of magnitude across tools, but it is not clear that the resulting monetary values for each metric within the tools are appropriately scaled.

While most of these methods have a criterion for Environmental Stewardship, there is a large divergence of the measures used to evaluate this factor. While emissions are most commonly named, an assortment of other related measures including the impact of investments on wetlands, sinkholes, environmental health, and sustainability are considered. To be able to compare across modes, this is a category for which some sort of uniform standards for measurement might prove to be helpful in the future, especially as environmental factors are increasingly of concern to the public.

A consistent limitation is in accounting for the impacts of shifting modes. Many tools have a tendency to overestimate the magnitude of the volume that would shift to non-highway modes as opposed to create additional demand. This treatment compounds as costs and environmental impacts and the value of reductions in congestion for non-highway modes build on the volume estimates.

Adjusting to present value and using consistent discount rates across modes is also critical, as projects for some modes would have impacts over longer time frames. Of the tools that documented a particular discount rate, a range between 3% and 7% was observed.

While benefit-cost tools are perhaps more easily comparable across modes, their utility in measuring and monetizing can overlook other important factors that can be addressed in a scorecard framework. A paired benefit-cost tool and scorecard is most likely to allow for objective comparison across modes without ignoring less measurable factors.

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