TWIN CITIES METRO FREIGHT INITIATIVE

PERFORMANCE MANAGEMENT FRAMEWORK

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Performance Management Framework

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Purpose

As the demand for freight and passenger transportation continues to increase faster than our ability to manage current transportation facilities or provide new ones, we can expect increased congestion and lower mobility, as well as degradation of safety, environmental and other factors by which we evaluate freight transportation quality. Consequently, freight performance measures and indicators become important by enabling us to understand freight system problems better. At the same time, they help us generate more viable solutions to address root causes when we organize them in a framework for:

- balancing competing goals and objectives, (e.g., safety, mobility, environmental quality); and
- setting priorities among alternative actions to resolve freight issues.

The following framework is intended as a reference for MnDOT and Met Council as they develop the details of and seek input on a strategy for improving the Twin Cities' freight system. We leave as a future step the identifying of a core set of measures and indicators on which to focus in terms of data collection, data analysis, as well as planning and policy application. Such a core set could be the basis for a dashboard to reference in managing the Twin Cities' freight system.

Overview

The content of indicators and measures in the draft framework derives largely from existing policy-related documents of MnDOT and Met Council (see References). In addition to the policy or strategic goals of MnDOT and of Met Council, we examined the newly released National Cooperative Freight Research Program report, "Performance Measures for Freight Transportation," (NCFRP 10, 2011). [This report proposes a number of performance measures listed in Appendix A.] As a result, we considered five policy/strategic goals:

- ***Safety / security***. This corresponds to the Freight Safety measures of NCFRP 10, but also adds measures related to freight security.
- ***Infrastructure preservation***. This corresponds to the System Condition measures of NCFRP 10.

- ***Mobility***. This corresponds to the Freight Demand and System Efficiency measures of NCFRP 10. Freight Demand is an indicator of modal balance, while the system efficiency measures are more directly focused on congestion.
- ***Accessibility to Key Centers*** (Economic Development). This focuses on the economic competitiveness of the Twin Cities, by looking at access between the Twin Cities and other markets.
- ***Community and Environmental Sustainability***. This corresponds to the Environmental Condition measures in NCFRP 10.

Appendix B maps the above goals to the overall goals of MnDOT's Statewide Transportation Plan and its Statewide Freight Plan, and Met Council's Transportation Policy Plan (TPP).

Successful performance measures have a number of characteristics:

1) ***First***, they are relevant to policy objectives. For example, measuring fatalities is highly relevant to the policy objective of safety.
2) ***Second***, data that support the performance measures exist, and can be collected systematically.
3) ***Third***, the level of detail of a performance measure matches the action being contemplated. For example, if the action is to improve an at-grade railroad crossing, the appropriate performance measure might be train-vehicle crashes at that crossing, and not statewide crashes.

This document includes a number of possible performance measures to use in defining and finalizing the list of solutions to freight issues in the Twin Cities. Some are already in use for other purposes; others will need to be examined in light of the three characteristics mentioned above to see how they can be refined, or even if they should be retained.

Using Performance Measures in Readiness Assessments

Performance measures are typically used to assess the overall performance of a transportation system. With several additional considerations, they can also be used to assess and prioritize specific projects. These considerations include:

- Can the measure be brought down to the level of detail that is commensurate with the action being considered? For example, if safety at a particular

intersection is being improved, the appropriate measure is crashes at that intersection, not crashes statewide.

- Can the impact of a project on the future value of a performance measure be predicted? For a project related to mobility, it might be desirable to run both the no-build and build scenarios through a traffic flow model, to assess mobility impacts. For a safety project, FHWA has published crash reduction factors that attempt to quantify the expected safety improvement from various actions. (http://safety.fhwa.dot.gov/tools/crf/)

As an example, suppose there is an issue with truck crashes on a particular section of freeway. The use of performance measures (in this case, number of crashes on a particular road segment) will reveal that there is an issue. Further investigation will likely reveal possible causes and solutions. For example, these crashes may be the result of merge conflicts at an inadequate on-ramp. A possible solution is to extend the length of a freeway on-ramp in order to facilitate truck merging. Then, two questions related to performance measures need to be answered:

1) What strategic goals are being addressed with this action? Possibilities include highway safety (e.g., fewer crashes due to merge conflicts), highway mobility (e.g., less congestion caused by merge conflicts) and community /environmental sustainability (e.g., less congestion leading to less fuel consumption and emissions).
2) If the ramp is improved, what kind of improvement in safety, mobility and environmental sustainability can be expected? How does it compare to the cost of the improvement?

Indicators and Performance Measures

Table 1 presents a color-coded index of strategic goals and modes for each of the subsequent tables. Table 2 shows performance measures and indicators for all modes (no color), with Tables 3 through 6 completing this index for the four primary modes of highway (yellow), rail (orange), air (grey) and water (blue). For each strategic goal, each table includes the following elements:

- ***Indicators***: trends that affect the mode's performance in terms of the goal; usually not precise in terms of specific locations or impact; early warning signals that something may need attention; indicators are also used where MnDOT has

limited influence, or the performance metric is not yet well-enough defined to provide a measure than can be managed.

- ***Performance Measures***: how well a mode is performing with respect to the goal; can be used to show changes over time, when compared

Table 1: Summary of Metro Freight System Performance by Mode

Strategic Goals	All Modes	Highway	Rail	Air	Water
	See Table 2	*See Table 3*	*See Table 4*	*See Table 5*	*See Table 6*
Safety/Security					
Infrastructure preservation					
Mobility (LOS, congestion, travel time reliability)					
Accessibility to key centers (economic development)					
Community and Environmental sustainability					

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Table 2: Performance Management Information for All Modes

Strategic Goals	All Modes
Safety/Security	• ***Performance measures:*** o Fatalities o Serious injuries • ***Indicators***: o Trends in insurance costs o Facilities with security vulnerabilities o System resilience: availability of alternate routes
Infrastructure preservation	• ***Performance measures***: o Deficient infrastructure elements (bridges for rail / road, locks for water, pipelines) o Pavement / track condition o Age of infrastructure/adequacy (grade crossing signals and traffic signals) • ***Indicators***: Trends in deficient infrastructure
Mobility	• ***Performance Measures:*** o Duration and extent of congestion o Other congestion measures under development o Metro area delay estimates for freight • ***Indicators***: o Ton-miles and dollar value carried by mode
Accessibility to key centers (economic development)	• ***Indicators***: o Cost of goods movement and travel time on key corridors (e.g., Twin Cities to Chicago) o Number of key centers with adequate highway, rail or water access o Adequacy of intermodal roadway connector routes o Rail abandonments.
Community and environmental sustainability	• ***Performance Measures:*** o Freight-related emissions and fuel consumption o Hazardous material releases • ***Indicators:*** o Percent of transportation facilities with appropriate zoning in affected areas o Noise/vibration – railroad quiet zones

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Table 3: Highway Performance Management Information by Strategic Goals

Strategic Goals	Highway
Safety/Security	• ***Performance Measures:*** o Heavy commercial vehicle-related fatalities, injuries and crashes, by road segment • ***Indicators***: o Overnight parking availability and usage
Infrastructure preservation	• ***Performance Measures:*** o Bridge condition on principal arterials (% poor) o Pavement ride quality (% poor) by functional class (principal arterial, other arterial) o Condition of railroad grade crossings on major truck routes (specifically adequacy of stacking distance and need for traffic signals/preemption) • ***Indicators***: o Number of bridges and roads with weight restrictions o Number of railroad grade crossings on major truck routes
Mobility	• ***Performance Measures***: o Duration and extent of congestion on freeways (peak hour spreads) o Metro area delay estimates for freight o Clearance time for metro-urban freeway incidents • ***Indicators***: o Truck vehicle miles traveled o Ton-miles and dollar value carried
Accessibility to key centers (economic development)	• ***Performance Measures:*** o Cost of goods movement and travel time on key highway corridors (e.g., Twin Cities to Chicago) o Average truck trip time between trade centers o Percent of interregional corridors meeting MnDOT standards for travel speed, o Number of detours for trucks, o Number of key centers with adequate highway access o Adequacy of intermodal connector routes • ***Indicators***: o Infrastructure (bridges with weight restrictions, roundabouts) that requires out-of-route truck o Rail abandonments.

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Strategic Goals	Highway
Community and environmental sustainability	o ***Performance Measures:*** Freight Related Emissions / ton-mile o Freight Related Fuel consumption / ton-mile o Hazardous material releases • ***Indicators***: o Number of major developments that have adequate truck/rail/water access, avoiding significant through truck travel in residential areas. o Grade crossings that have a high number of hazardous material truck traffic

Table 4: Rail Performance Management Information by Strategic Goals

Strategic Goals	Rail
Safety/Security	• ***Performance Measures:*** o Train crashes, including derailments o Crossing-related fatalities and crashes on all roads
Infrastructure preservation	• ***Performance Measures:*** o Short line rail track capacity and condition o Percent of short-line (Class 3) railroad track that can be operated at 25 MPH or above o Percent of Class I railroad track that can be operated at 25 MPH or above o Number of grade crossings with antiquated signal systems o Rail bridge condition
Mobility	• ***Indicators***: o Ton-miles and value of rail freight moved o Container freight lifts (intermodal activity) o Adequacy of road connections to key rail facilities o Positive Train control impacts to freight movements
Accessibility to key centers (economic development)	• ***Performance Measures:*** o Number of key centers with adequate rail access o Cost of goods movement and travel time on key rail corridors (e.g., container rail between Twin Cities and Los Angeles, Seattle and Chicago) o Adequacy of train movements within the Twin Cities metro area (east/west and north/south) • ***Indicators***: o Rail abandonments o Adequacy of intermodal connector routes
Community and environmental sustainability	• ***Performance Measures:*** o Grade crossing delays o Emissions / ton-mile o Fuel consumption / ton-mile o Hazardous material releases • ***Indicators***: o Rail yard activity near residential areas o Quiet zones

Table 5: Air Performance Management Information by Strategic Goals

Strategic Goals	Air
Safety/Security	• ***Performance Measures:*** o Crashes, security incidents (little MnDOT role) o General aviation fatalities o General aviation accidents
Infrastructure preservation	• ***Performance Measures:*** o Pavement condition for public airports
Mobility	• ***Performance Measures:*** o Flight delays at MSP compared with other airports • ***Indicators:*** o Air cargo tonnage and value o Nonstop air destinations from MSP o Nonstop air freight destinations from MSP
Accessibility to key centers (economic development)	• ***Performance Measures:*** o Percent of MN population within 20 miles of airport with paved and lighted runway (existing measure) o Percent of MN population within 60 minutes of an airport with cargo activity o Latest drop time for overnight air shipments
Community and environmental sustainability	• ***Performance Measures:*** o Percent of publicly funded Minnesota airports that have Airport Safety Zoning o Freight related fuel consumption o Freight-related emissions

Table 6: Water Performance Management Information by Strategic Goals

Strategic Goals	Water
Safety/Security	• ***Performance Measures:*** o Insurance cost per $1000 of cargo
Infrastructure preservation	• ***Performance Measures:*** o Age of river locks o Port asset condition rating
Mobility	• ***Performance Measures:*** o Waterway lock capacity utilization and transit time (see Freight audit) o Physical lock and river capacity (maximum number of barges in one tow) o Availability of container handling or bulk transfer capability • ***Indicators:*** o Tonnage and value of freight carried by barge to/from Twin Cities river ports
Accessibility to key centers (economic development)	• ***Performance Measures:*** o Number of key economic centers with direct barge service o Adequacy of road connections to key port facilities o Cost of goods movement and travel time on key water corridors (e.g., St. Paul to New Orleans) • ***Indicators***: o Changes in number of ports with substantial barge activity
Community and environmental sustainability	• ***Performance Measures:*** o Hazardous material releases o Fuel consumption / ton-mile o Emissions / ton-mile

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Appendix A: Freight Summary Report Card from NCFRP 10

Freight Demand Measures

Freight Demand Measures, All Modes
Despite declines in the past 18 months, steady growth in freight volumes occurred over the past 10 years. Future long-term growth of 2-3 % annually for 20 years is likely as the economy improves.

Truck Freight Volumes
Truck freight grew at 2 to 3% annually in the past decade, except in the past 18 months. Future 2-3% growth is predicted when the economy improves to historic levels

Rail Freight Volumes Rail freight volumes steadily grew in the 2000s until the recent recession. Long-term rail freight volumes are predicted to continue growing with an economic rebound.

Inland Water Freight Volumes Inland water traffic growth is expected to remain at relatively low rates of 1% to 1.5% through 2035, the rate of growth for the past 10 years.

Containerized Waterborne Freight Volumes
Containerized freight volumes grew rapidly in the past decade until 2008, when they sharply declined. Long-term growth is likely to resume to previously robust levels with improvement in the global economy.

System Efficiency Measures

Interstate Highway Speeds
A near doubling of traffic volumes in the past 25 years has slowed peak-hour speeds in most urban areas. Long-term traffic growth is likely to continue to outpace physical or operational improvements to the Interstate System. As a result, travel speeds are likely to continue declining.

Travel speeds at top Interstate Highway Bottlenecks
Rising traffic volumes combined with a low rate of investment are likely to result in slower travel speeds and increased delays at the nation's top Interstate Highway bottlenecks.

Interstate Highway Reliability
Definitive Interstate Highway System reliability data do not exist for the past decade. However, increases in traffic volumes and freight volumes are well documented and extensive localized data indicate that travel on urban Interstate highways has become less reliable. ATRI reliability measurement on 25 Interstate corridors indicates variability in reliability on congested urban segments, with future traffic volumes expected to increase. It is reasonable to assume that reliability will worsen if current trends continue.

Class I RR Operating Speed
Operating speeds at Class I railroads have remained stable for the past decade. The RRs warn of long-term congestion and delay if investment levels are not increased.

Cost of Logistics as a Percent of GDP
After decades of decline, logistics as a cost of GDP has become more uncertain. It rose in the mid-2000s but fell significantly with the recession of 2008. The decline was due to unsustainable conditions such as freight prices falling below costs.

System Condition Measures

NHS Pavement Conditions
Approximately 50% of the NHS pavement conditions are 'Good', representing improvement over the past decade. However, higher costs and uncertain funding levels create uncertainty whether those relatively low levels can be sustained.

NHS Bridge Conditions
Structural deficiencies on the NHS have declined by 40% in recent decades and were forecast to continue improving. However, dramatically higher material prices in the past two years and uncertain funding levels threaten the long-term improvements that had been achieved.

Environmental Condition Measures

Freight-Produced Greenhouse Gas Emissions (GHG)
Freight-produced greenhouse gas emissions are expected to rise commensurate with the increase in truck, rail, and water freight volumes. Current emission technology does not control vehicular GHG.

Truck Greenhouse Gas Emissions
Truck-related GHG are predicted to rise steadily with a projected 30% increase in vehicle miles traveled by 2030.

Rail Greenhouse Gas Emissions
Rail GHG steadily increased from 1990 to 2005 but leveled off because of declining rail volumes and cleaner locomotives.

Freight-Produced Ozone-Related Emissions
Ozone precursors from trucks have declined dramatically in recent years and are predicted to continue to decline as cleaner vehicles replace current ones and as the benefits of cleaner fuel are realized.

Truck-related Volatile Organic Compounds (VOCs)
These ozone-contributing emissions produced by trucks have fallen dramatically because of cleaner fuels, and vehicles.

Truck-related Nitrogen Oxide (NOX) emissions Truck-generated NOx emissions are forecasted to fall 82% from 2002 levels by 2020 because of cleaner fuels and vehicles.

Rail NOX Emissions
The elimination of sulfur from fuel and introduction of cleaner locomotives are expected to reduce RR NOx emissions by 41% by 2020 and by 83% by 2040.

Rail VOC Emissions
The same fuel and locomotive changes are forecasted by USEPA to reduce per gallon diesel emissions of VOCs by 60% by 2020 and by 88% by 2040.

Truck Particulate Emissions
Cleaner low-sulfur fuel and cleaner engine technology are predicted to lead to an 82% reduction in combination truck particulate emissions.

Ship produced NOX and PM
Similar fuel and engine improvements are required for U.S.-flagged merchant vessels. Both PM and NOx emissions are predicted to decline significantly through 2040 on a per-gallon basis.

Freight Safety Measures

Truck Injury and Fatal Crashes

Between 1988 and 2007, the large truck injury crash rate decreased from 67.9 to 31.8 per million miles traveled. The 2007 rate is the lowest on record. The large truck fatal crash rate has also declined. In 2007, this rate was 1.85, down from a peak of 5.21 in 1979. The 2007 rate is the lowest rate on record.

Highway/Rail At-Grade Crashes

Between 1998 and 2008 the number of incidents at RR crossings involving both vehicles and pedestrians declined 32%. Nearly 2,400 annual incidents still occur, with 289 deaths in 2008.

System Investment Measures

Estimated Investment in the National Highway System (NHS) to Sustain Conditions

The 2004 FHWA Condition and Performance Report indicated that then-current investment levels were adequate to sustain most NHS conditions. However, since then construction costs increased significantly and funding for the federal highway program remains undecided.

Rail Freight Industry Earning Cost of Capital

The Cost of Capital for the Class I railroads has steadily declined, which is a positive economic trend for them. Lower Cost of Capital reflects lower costs to acquire capital to improve the rail network.

Estimated Rail Capital Investment to Sustain Market Share

A rail industry analysis concluded that the Class I RRs need to increase capital investment in expansion to sustain market share. Their ability to raise sufficient investment capital is not definite and may not be sufficient to sustain market share.

Inland Waterway Investment to Sustain Lock and Dam Average Age at Less than 50 Years

The average age of locks on the inland waterways system is estimated to be in excess of 51 years. Current expenditure levels do not appear to be sufficient to improve that average age.

Appendix B: Relationship of Performance Management Goals to Goals in Other MnDOT and Met Council Strategic Planning and Policy Documents

The table below shows the strategic goals in this document, and related goals in the Minnesota Statewide Transportation Plan, the Statewide Freight Plan and the investment policies in the Metro Council Transportation Policy Plan.

This Document	Statewide Transportation Plan (2009)	Statewide Freight Plan (Ch. 8) (2005)	Met Council Transportation Policy Plan (Investment Policies) (2010)
Safety/Security	• Traveler Safety • Maintenance & Security	• Enhance the Operational Performance and Safety of Statewide Freight Systems • Streamline and Improve the Effectiveness of Motor Carrier Regulatory Activities	
Infrastructure Preservation	• Infrastructure Preservation		• Ensure Adequate Resources for Transportation System Investments • Prioritizing for Regional Transportation Investments
Accessibility to Key Centers	• National & Global Connections • Statewide Connections	• Improve the Condition, Connectivity and Capacity of National and International Freight Infrastructure Serving Minnesota • Improve the Condition, Connectivity, and Capacity of Statewide Freight Infrastructure	• Investments in Regional National and Global Connections

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This Document	Statewide Transportation Plan (2009)	Statewide Freight Plan (Ch. 8) (2005)	Met Council Transportation Policy Plan (Investment Policies) (2010)
Mobility	• Twin Cities Mobility • Greater Minnesota Metropolitan and Regional Mobility		• Investments in Regional Mobility
Community and Environmental Sustainability	• Community Development and Transportation • Energy and the Environment	• Enhance Integration of Freight into Regional and State Transportation Planning and Investment Decisions • Strengthen Partnerships to Address Significant Freight Issues	• Coordination of Transportation Investments and Land Use Investments in Preserving Right of Way • Energy and Environmental Considerations • Public Participation in Transportation Planning and Investment Decisions