MISSOURI
State Freight & Rail Plan

GOALS, OBJECTIVES AND PERFORMANCE MEASURES

JANUARY 2022

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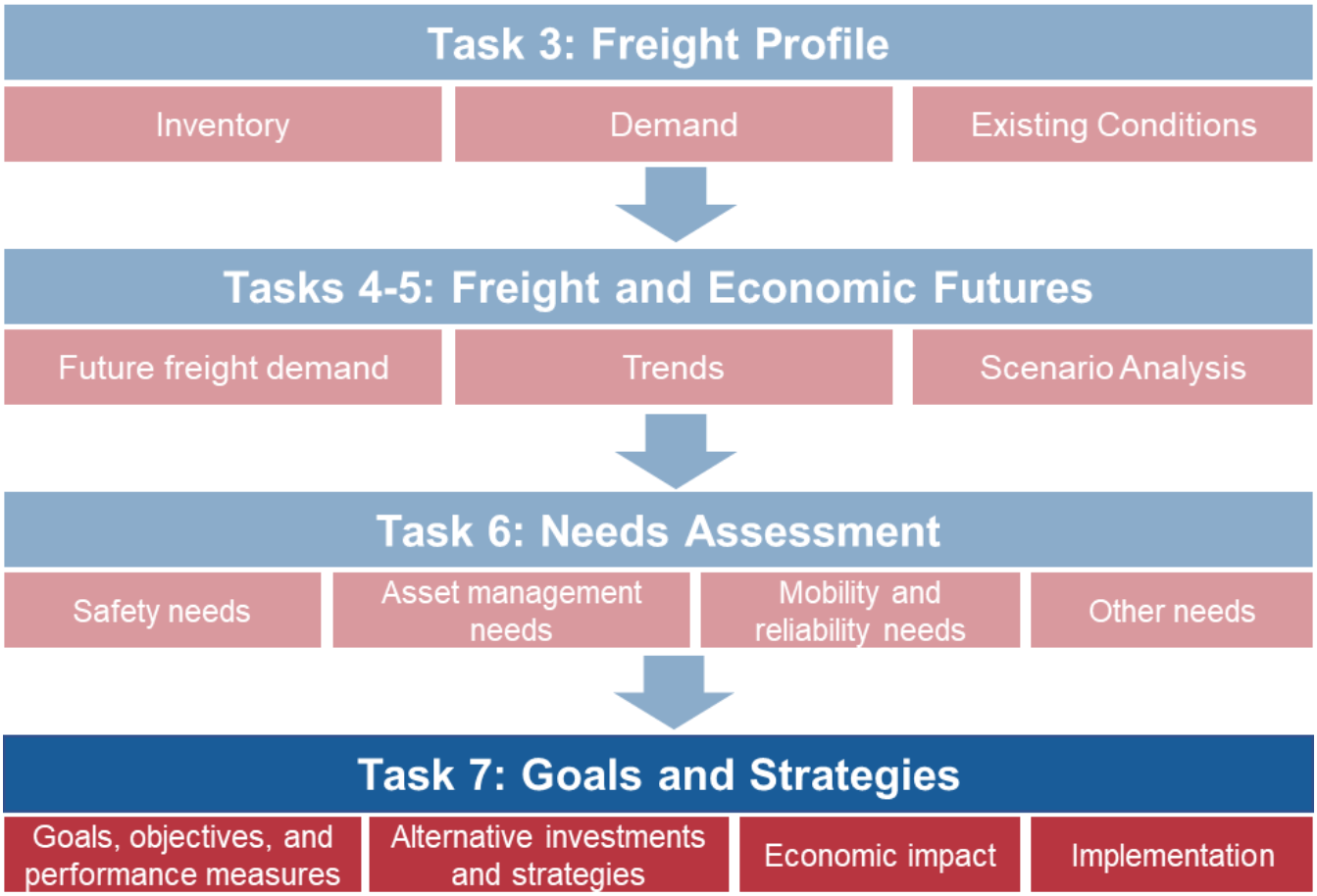
1.0 Introduction

The Missouri Department of Transportation is developing this State Freight and Rail Plan to provide MoDOT with a next-generation blueprint and plan for multimodal freight and passenger rail investment for the future. This plan is data-driven and supported by stakeholders and is intended to help Missouri maintain its competitive advantage and economic vitality aligned with freight movement within the state. Figure 1.1 shows the overall sequence of events for the development of this plan.

FIGURE 1.1 MISSOURI STATE FREIGHT AND RAIL PLAN TASK BREAKDOWN



MoDOT developed goals and objectives to meet the growing needs of the state to provide safe and efficient people and goods mobility and compete globally for quality jobs. The goals and objectives established for the 2022 SFRP build on the 2018 Long Range Transportation Plan goal areas and were informed by stakeholder outreach, national best practices, and other related MoDOT planning efforts to drive performance measures and ultimately multimodal freight and passenger rail investment decision-making.

This report will detail the goals, objectives (Section 2.0) and performance measures (Section 3.0) established for the 2022 SFRP.

2.0 Goals and Objectives

The 2022 SFRP goals establish the foundation upon which the SFRP can be built and implemented. This section reviews goals established by MoDOT and the USDOT and establishes goals for the 2022 SFRP. In addition to establishing seven goals, the SFRP also defines clear objectives to provide MoDOT guidance toward achieving each goal area.

2.1 Review of Existing MoDOT Goals

The goals established as part of the 2022 SFRP will direct MoDOT's vision and direction for the future of the freight system as well as Missouri's passenger rail system. As the state's first integrated state freight and rail plan, the 2022 SFRP must build upon the goals established in previous plans to capture all the desired outcomes for the multimodal freight system and passenger rail network.

In January 2018, MoDOT initiated a comprehensive review of its management processes and incentive structures used to deliver transportation infrastructure efficiently and safely. This review led to a series of institutional changes crafted within three core values for the agency: safety, service and stability. MoDOT also established seven goals within each of the three core values to represent the agency's fundamental principles and philosophy, as shown in **Figure 2.1**

FIGURE 2.1 MODOT CORE VALUES AND GOALS

Safety
- Moving Missourians safely.

Service
- Providing outstanding customer service.
- Delivering efficient and innovative transportation projects.
- Operating a reliable transportation system.

Stability
- Managing our assets.
- Stabilizing resources and engaging our workforce.
- Building a prosperous economy for all Missourians.

These seven goals are also known as MoDOT's Tangible Results, which are what MoDOT's customers see or experience as the department fulfills its mission. Efforts towards achieving tangible results are documented in MoDOT's Tracker. This quarterly publication of 49 performance measures details MoDOT's progress toward the fulfillment of the department's mission, values and tangible results. The performance measures that support the 2022 SFRP are described in Section 3.0.

Further building on MoDOT's agency core values and goals, the 2018 Long Range Transportation Plan identified a series of goals that align with the transportation vision of Missourians. The goals established as part of that citizen-led effort are as follows:

- Take care of the transportation system and services we enjoy today.
- Keep all travelers safe, no matter the mode of transportation.
- Invest in projects that spur economic growth and create jobs.

- Give Missourians better transportation choices.
- Improve reliability and reduce congestion on Missouri's transportation system.

Another important planning effort supported by MoDOT is *Show Me Zero*, which was led by the Missouri Coalition for Roadway Safety. Show Me Zero is a plan to address safety conditions and driver behavior on Missouri's roadways over a five-year period, addressing four key behaviors that contribute to the majority of roadway injuries and fatalities: occupant protection, distracted driving, speed and aggressive driving and impaired driving. The Show Me Zero plan also documented more than 100 strategies targeted at 11 group types, including families and individuals, schools, public agencies, health professionals and law enforcement agencies. The strategies provided to public works and engineering departments are categorized into five topic areas: safety planning and prioritization; lane departure crashes; intersection crashes; pedestrians and non-motorized users; and transportation systems management and operations. Although most of the strategies target engineering strategies to enhance Missouri's roadway safety, there are some recommendations pertaining to rail crossings, including expanding current light and gate projects at rail crossings; closing some rail crossings and creating grade-separated intersections at rail crossings.

In addition, MoDOT is working on the Highway-Rail Grade Crossing State Action Plan, which is expected to be completed in Spring 2022.

2.2 Comparison to MoDOT and National Best Practices

The goals established for the 2022 SFRP not only build on the goals established during the 2017 State Freight Plan and 2012 State Rail Plan (see Appendix A), but they also align with MoDOT agency goals and national goals, as well as local plans and policies that already exist or are in development. Table 2.1 compares National Multimodal Freight Policy goals established by USDOT in the FAST Act with relevant MoDOT goals discussed in Section 2.1.

MoDOT is built on a foundation of three core values: safety, service and stability. The goals established for the aforementioned planning efforts not only reflect those values but guide efforts toward additional goals for Missouri's economic growth, quality of life, and environmental sustainability, among others. Table 2.1 organizes National Multimodal Freight Policy goals, MoDOT agency goals, LRTP goals, and the 2022 SFRP goals within those three core values.

TABLE 2.1 COMPARISON OF NATIONAL AND MODOT GOALS BY SOURCE AND CORE VALUE

Core Value	National Multimodal Freight Policy	MoDOT	2018 Long Range Transportation Plan	2022 State Freight & Rail Plan
Safety	• Improve the safety, security, efficiency and resiliency of multimodal freight transportation. • Use innovation and advanced technology to improve the safety, efficiency and reliability of the NMFN.	• Move Missourians safely	• Keep all travelers safe, no matter the mode of transportation	• Safety: Improve safety and security of the multimodal freight and passenger rail system by supporting efforts to decrease the number and severity of freight vehicle crashes, increase truck parking options, and improve safety throughout the multimodal freight system and the passenger rail network.
Service	• Improve the short- and long-distance movement of goods that travel across rural areas between population centers; between rural areas and population centers; and from the nation's ports, airports, and gateways to the NMFN. • Reduce the adverse environmental impacts of freight movement on the NMFN. • Improve the flexibility of states to support multi-state corridor planning and the creation of multi-state organizations to address freight connectivity. • Improve the reliability of freight transportation.	• Provide outstanding customer service • Deliver efficient and innovative transportation projects • Operate a reliable transportation system	• Give Missourians better transportation choices • Improve reliability and reduce congestion on Missouri's transportation system	• Connectivity and Mobility: Improve the connectivity and mobility of the multimodal freight and passenger rail system by reducing congestion on the roadways; increasing reliability of the roadways and passenger rail network; supporting improved efficiency of rails, waterways, and airports; and improving connections between freight modes and between passenger rail and other passenger travel modes. • Equity and Environmental Resiliency: Support equity and environmental resiliency of the multimodal freight and passenger rail system. • Customers and Partnership: Improve coordination and collaboration with regional planning partners and multimodal freight and passenger rail stakeholders.
Stability	• Achieve and maintain a state of good repair on the NMFN. • Pursue the goals described above in a manner that is not burdensome to state and local governments. • Improve the economic efficiency and productivity of the NMFN. • Identify infrastructure improvements, policies and operational innovations that strengthen contribution of the NMFN to the economic competitiveness of the U.S.; reduce congestion and eliminate bottlenecks on the NMFN; and increase productivity, particularly for domestic industries/businesses that create high-value jobs.	• Manage our assets • Stabilize resources and engage our workforce • Build a prosperous economy for all Missourians	• Take care of the transportation system and services we enjoy today • Invest in projects that spur economic growth and create jobs	• Maintenance: Maintain the multimodal freight and passenger rail system in good condition by keeping highways and bridges in good condition and supporting the maintenance of railways, waterways, airports, and multimodal connections. • Economy: Support economic growth and competitiveness in Missouri through strategic improvements to the multimodal freight network and passenger rail system. • Process and Innovation: Institute policies and practices that support the multimodal freight and passenger rail systems, encourage innovation, and promote an efficient use of resources.

2.3 2022 SFRP Goals and Objectives

This evaluation of national and state goals provides a clear and strong foundation from which the SFRP goals were established. Based on this analysis and the strategic input of MoDOT staff and planning partners, seven goal areas were identified to align with national and state priorities, covering system-related goals as well as goals related to the planning process, collaboration with stakeholders and ultimately implementation of the SFRP. The 2022 SFRP goals are:

- **Maintenance**: Maintain the multimodal freight and passenger rail system in good condition by keeping highways and bridges in good condition and supporting the maintenance of railways, waterways, airports and multimodal connections.
- **Safety**: Improve safety and security of the multimodal freight and passenger rail system by supporting efforts to decrease the number and severity of freight vehicle crashes, increase truck parking options, and improve safety throughout the multimodal freight system and the passenger rail network.
- **Economy**: Support economic growth and competitiveness in Missouri through strategic improvements to the multimodal freight network and passenger rail system.
- **Connectivity and Mobility**: Improve the connectivity and mobility of the multimodal freight and passenger rail system by reducing congestion on the roadways; increasing the reliability of the roadways and passenger rail network; supporting improved efficiency of rails, waterways, and airports; and improving connections between freight modes and between passenger rail and other passenger travel modes.
- **Equity and Environmental Resiliency**: Support equity and environmental resiliency of the multimodal freight and passenger rail system.
- **Process and Innovation**: Institute policies and practices that support the multimodal freight and passenger rail systems, encourage innovation and promote an efficient use of resources.
- **Customers and Partnership**: Improve coordination and collaboration with regional planning partners and multimodal freight and passenger rail stakeholders.

The 2022 SFRP also defines clear objectives to guide MoDOT through each goal area. The updated objectives address both the multimodal freight and passenger rail priorities of the SFRP, building upon previously established objectives and integrating new objectives related to connectivity and mobility, equity and environmental resilience, and economic growth. The 2022 SFRP goals and objectives are shown in Table 2.2.

TABLE 2.2 2022 SFRP GOALS AND OBJECTIVES

Tracker Core Value	2022 SFRP Goal Area	2022 SFRP Objectives
Safety	Safety	• Decrease the number and severity of crashes involving commercial motor vehicles. • Improve grade crossing surfaces, utilize warning devices and pursue road closures and grade separations where appropriate • Support the safe movement of maritime and aviation freight. • Promote the safe transportation of hazardous materials. • Support cooperative efforts with Amtrak and freight railroads to enhance the security of passenger and freight operations. • Support the maintenance and development of safe and secure truck parking facilities for commercial vehicle drivers.
Service	Connectivity & Mobility	• Support the development of intermodal freight facilities to increase connectivity between air, rail, truck and water modes to increase access to domestic and global markets. • Reduce congestion and increase reliability on roadways and freight intermodal connectors, including connections to freight generators. • Support and encourage improved efficiency of railroads, waterways, and airports. • Support intermodal connectivity between intercity passenger rail and other passenger modes including air, local transit, auto, intercity bus and non-motorized transportation to facilitate efficient and reliable passenger mobility. • Support new and enhanced passenger rail service to Missouri communities and travelers as an efficient and cost-effective mobility alternative. • Reduce passenger rail travel times through increased speeds and reduced delays. • Improve passenger rail reliability and performance. • Increase frequencies on the existing rail route. • Support the connectivity of Missouri passenger rail service to other corridors regionally, nationally, and internationally to maximize network benefits in terms of increased ridership, revenues and passenger mobility.
	Equity & Environmental Resiliency	• Support opportunities for alternative fueling infrastructure. • Support expanded multimodal freight and passenger rail service as a part of an overall state energy conservation policy to protect Missouri travelers and shippers from the adverse mobility and economic impacts of expected increases in future transportation energy costs. • Support expanded multimodal freight and passenger rail service as a means of reducing carbon emissions and fuel consumed per ton- and per passenger-mile and increasing the resiliency and redundancy of the system against extreme weather events. • Increase passenger rail accessibility to low income, elderly and special needs groups who have limited access to auto and other modes.
	Customers & Partnership	• Provide a satisfactory ridership experience for passenger rail customers. • Regularly and meaningfully engage with multimodal freight and passenger rail stakeholders, industry and planning partners.
Stability	Maintenance	• Keep Missouri highways and bridges in good condition. • Support and encourage the maintenance of railways, waterways, airports and multimodal connections.

	Economy	• Enhance and support opportunities for economic development, business expansion and attraction and job growth through improvements to the multimodal freight system. • Promote multimodal freight service, infrastructure improvements, and intermodal connectivity to increase the efficiency of multimodal freight modes, lower transportation costs for Missouri businesses, and provide increased access to global markets. • Enhance resiliency and develop redundancy for the multimodal freight and passenger rail system to increase reliability for movement of passengers and freight. • Provide enhanced passenger rail service to Missouri communities as a part of an overall economic development strategy to increase employment, household incomes and property values based on the increased accessibility and mobility. • Leverage federal and state dollars through discretionary funding opportunities to deliver critical multimodal freight and passenger rail infrastructure investments.
	Process & Innovation	• Support the efficient use of resources in multimodal freight and passenger rail planning efforts. • Encourage the use of technology to improve the safety, efficiency and accuracy of multimodal freight and passenger rail planning efforts.

3.0 Freight & Passenger Rail Performance Measures

Multimodal freight and passenger rail performance measures provide quantitative evidence of how well the freight and rail system performs by identifying and tracking challenges faced by the transportation system, including underlying drivers. Addressing these challenges and assessing the improvement, or deterioration of the system, relies on monitoring performance relative to established targets. These targets help determine the impact and success of investments and initiatives which is not possible without performance measures.

Performance measures rely on the availability of data and analysis methods available. A measure will be of no value to the agency if reliable data cannot be consistently obtained to compute the measure. Some important considerations when selecting freight performance measures are:

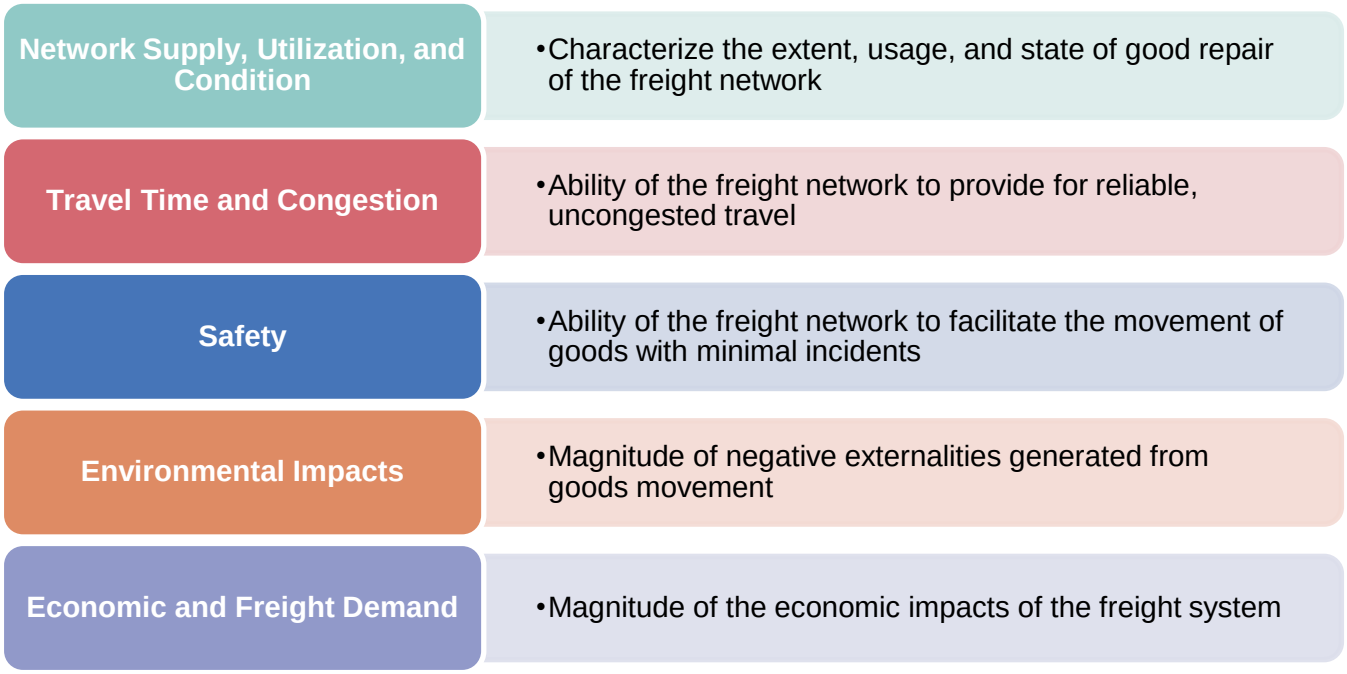
- Performance measures should have a clear relationship to goals and objectives;
- Performance measures should be relevant to the public and decision-makers; and
- Performance measures should have data that is readily available, reliable, timely and of high quality.
- Ideally, performance measures should be influenced or completely actionable by MoDOT.

This section provides an overview of the types of multimodal performance measures and presents the multimodal freight and passenger rail performance measures established as part of this SFRP. Appendix B provides more information about MoDOT's previous freight performance measures established as part of the 2017 SFP, as well as information about national and peer state best practices.

3.1 Overview

Freight performance is broadly defined in terms of the characteristics and quality of freight system condition, utilization, operations, and economic outcomes. Figure 3.1 shows the categories of freight performance measures as defined and used in this study. They include measures of network supply, utilization, and condition that characterize the physical infrastructure and freight volumes on it; measures of travel time and congestion that characterize the quality of freight mobility; measures of safety; environmental measures that gauge the environmental impacts of freight; and economic and freight demand measures that gauge the freight system's economic impacts.

FIGURE 3.1 CATEGORIES OF FREIGHT PERFORMANCE MEASURES



Source: Cambridge Systematics, Inc.

Network Supply, Utilization and Infrastructure Condition

Network supply and infrastructure condition measures gauge the performance of the multimodal freight system by characterizing the extent, utilization, and condition of the system. In characterizing the extent and condition of the system, network supply and infrastructure condition-based measures provide insight into the accessibility of the multimodal freight system for its users. Performance measures that focus on utilization inform agencies on which portions of the multimodal network have the highest usage and may require greater prioritization from an investment perspective. Performance measures that focus on infrastructure condition provide insight into the accessibility of an area for freight as they indicate which origins and destinations have freight mobility and fluidity. Examples of this type of performance measure are included in Appendix B.

Travel Time and Congestion

Travel time and congestion-based freight performance measures are an important category of performance measures as these (along with safety) have the most direct impact on the cost of freight operations. Delays can be costly to shippers as they wait for delivery of time-sensitive goods such as an input to a manufacturing process or a consumer good that must make it to retailers in time for a busy shopping period. Delays are also costly to carriers as contracts for carriage typically include provisions for on-time deliveries that contain financial penalties for failing to do so. In addition, travel time and congestion-based freight performance measures also reflect the costs associated with factoring buffer time into schedules (and the associated labor, fuel, and other vehicle costs) to account for unanticipated delays. Data on travel times are typically derived from loop counters and GPS data.

The Truck Travel Time Reliability Index is a type of travel time-based freight performance measure and is the only freight-specific measure required by federal mandate.[1] TTTR does not necessarily indicate the efficiency of a route, just whether a driver will need to plan more time to travel that particular route. Reporting for the TTTR Index is divided into five periods: morning peak (6-10 a.m.), midday (10 a.m. – 4 p.m.) and afternoon peak (4-8 p.m.) Mondays through Fridays; weekends (6 a.m.-8 p.m.); and overnights for all days (8 p.m. – 6 a.m.). The TTTR ratio is calculated by dividing the 95th percentile truck travel time by the 50th percentile truck travel time for each segment. The TTTR Index is calculated by multiplying each segment's largest ratio of the five periods by its length, then dividing the sum of all length-weighted segments by the total length of Interstate. Higher values of the TTTR Index indicate less reliable truck travel while lower values indicate more reliable truck travel; a value of 1.0 means that travel time is reliable on a particular route. Congestion and reoccurring crashes are common on routes where TTTR is greater than 1.0. Examples of this type of performance measure are included in Appendix B.

Safety

Traffic incidents are a major cause of nonrecurring congestion and associated delay for freight operations. Furthermore, those incidents involving trucks or trains tend to be costlier in terms of the severity of crash outcomes and incident clearance times. Freight safety performance measures are essential to ensure the safety and security of people and goods movement on the multimodal transportation network. Typical freight safety performance measures cover various aspects of goods movement including the rate and severity of incidents, incidents involving multiple modes (e.g., train derailment on or near a highway or waterway, highway vehicle-rail incidents, etc.), and the supply and adequacy of truck parking. Examples of this type of performance measure are included in Appendix B.

Environmental Impacts

Environmental freight performance measures are critical to mitigating the negative externalities caused by the movement of freight. Trucks account for just under 10% of annual vehicle miles traveled,[2] but emit nearly 23% of all greenhouse gas emissions across all transportation modes. Reduction of idling, conversion to alternative fuel sources, use of the lowest greenhouse gas emissions' mode available and efficient transfers amongst freight modes can significantly reduce emissions and fuel consumption per ton. Environmental freight performance measures are not typically included in state freight plans. Examples of this type of performance measure are included in Appendix B.

Economic and Freight Demand Measures

Economic and freight demand performance measures are important because they provide insight into the factors that drive shippers to consume freight services and ultimately result in the physical manifestation of that demand – freight vehicles operating in the multimodal transportation network. In addition, these measures help state DOTs and other transportation agencies gauge the effectiveness of policies intended to improve the ability of the multimodal transportation system to work together more cohesively, efficiently and cost-effectively for shippers and carriers. A state's ability to provide a reliable multimodal freight network directly impacts available jobs, delivery

[1] 23 CFR Part 490 Section 607; Federal Highway Administration, https://www.fhwa.dot.gov/tpm/about/regulations.cfm.

[2] https://www.bts.gov/share-highway-vehicle-miles-traveled-vehicle-type

times for consumer goods, standard of living, quality of life and other measures of economic competitiveness. Examples of this type of performance measure are included in Appendix B.

3.2 2022 SFRP Performance Measures

Missouri has an expansive performance measurement program, known as Tracker, that originated several best practices identified in national studies and by other states with proactive freight transportation programs. The state's performance measurement management program is strengthened by its reliance on internal data sources wholly controlled by MoDOT and a limited number of trustworthy external data sources. Using Tracker and other publicly available sources, MoDOT will monitor 17 performance measures – some of which it already examines – evaluating freight and passenger rail transportation as a result of the 2022 SFRP process. Since establishing performance measures as part of the 2017 SFP, some have proved too difficult to track and have been removed from the list, while others have been added to result in a robust list of freight and rail performance measures. Table 3.1 shows the 2022 SFRP performance measures for Missouri by goal area.

TABLE 3.1 SFRP PERFORMANCE MEASURES

Performance Measure	Definition	Source
Maintenance: Maintain the multimodal freight and passenger rail system in good condition by keeping highways and bridges in good condition and supporting the maintenance of railways, waterways, airports, and multimodal connections.		
Percent of the major highways in good condition	Out of the state's 5,542 miles of highways, interstates and U.S. routes, Missouri has set a target to maintain 90 percent of higher in good condition.	MoDOT
Percent of structurally deficient deck area on NHS bridges	Tracks the percentage of structurally deficient deck area for bridges on the National Highway System. It is required by MAP-21 that the state tracks this measure with a target of fewer than 10 percent.	MoDOT
Safety: Improve safety and security of the multimodal freight and passenger rail system by supporting efforts to decrease the number and severity of freight vehicle crashes, address truck parking issues, and improve safety throughout the freight system and the passenger rail network.		
Number of commercial vehicle crashes resulting in fatalities or serious injuries	The Department tracks the number of commercial motor vehicles involved in fatal and serious injury crashes each year.	MoDOT
Rail crossing crashes or fatalities	Tracks annual trends in fatalities and collisions resulting from train-vehicle/ pedestrian crashes at public railroad crossings in Missouri.	MoDOT, Federal Railroad Administration
Rail inspections and defects found	Number of state/federal inspections, defects and violations recorded by MoDOT railroad staff	MoDOT

Performance Measure	Definition	Source
Economy: Support economic growth and competitiveness in Missouri through strategic improvements to the multimodal freight network and passenger rail system.		
Job growth by key sector (including agriculture, manufacturing and transportation/ logistics)	Tracks job and economic growth associated with each key industry.	Missouri Department of Economic Development; U.S. Bureau of Labor Statistics[3]
Port Investment	New capital investment at public ports	MoDOT
Port Jobs	Number of jobs at public port facilities	MoDOT
Connectivity and Mobility: Improve the connectivity and mobility of the multimodal freight and passenger rail systems by reducing congestion on highways; increasing reliability on highways and passenger rail network; supporting improved efficiency of rails, waterways, and airports; and improving connections between freight modes and between passenger rail and other modes.		
Freight tonnage by mode	Tracks the amount of freight moved by Missouri's largest transportation modes (Air, Water, Rail and Truck)	Highway: TRANSEARCH, FHWA FAF Rail: Surface Transportation Board, TRANSEARCH, FHWA FAF Air Cargo: Bureau of Transportation Statistics, TRANSEARCH, FHWA FAF Marine: U.S. Army Corps of Engineers, TRANSEARCH, FHWA FAF
Annual hours of truck delay	Delay is required by MAP-21 and is measured anytime trucks experience speeds 5 mph or more below the posted speed limit.	National Performance Management Research Data Set
Annual Hours of Truck Delay on Freight Intermodal Connectors	Annual total truck delay experienced on freight intermodal connectors	National Performance Management Research Data Set
Truck Reliability Index	Truck reliability measures how consistent truck travel times are on a corridor. The closer the index is to 1.0, the more reliable the corridor.	National Performance Management Research Data Set
River Port Volumes	Annual tonnage of freight cross docking at public river ports	MoDOT, U.S. Army Corps of Engineers
Unscheduled Lock Closure Time	Annual total hours of unscheduled closures of locks and dams in Missouri	U.S. Army Corps of Engineers
Passenger Rail Ridership and Performance	Number of rail passengers and on-time performance	MoDOT
Customers and Partnership: Improve coordination and collaboration with regional planning partners, multimodal freight and passenger rail stakeholders.		
Railroad complaints	Number of railroad complaints and number of days to close	MoDOT
Ridership satisfaction	Percent of customers satisfied with Amtrak service	MoDOT

[3] Employment for key Missouri sectors can be tracked on a monthly or annual basis via the U.S. Bureau of Labor Statistics website, available here: https://www.bls.gov/regions/mountain-plains/missouri.htm

4.0 Conclusion

This document described the strategic goals, objectives, and performance measures of the 2022 State Freight and Rail Plan and their relationship to federal legislative goals and previous state planning efforts, as well as national best practices. The goals, objectives, and performance measures established for the 2022 SFRP were designed to meet the growing needs of the state to compete globally for quality jobs and provide safe and efficient people and goods mobility. The goals and objectives were informed by stakeholder outreach, national best practices, and related MoDOT planning efforts – including the *2018 Long Range Transportation Plan* and *A Citizen's Guide to Missouri's Transportation Future* – and provided a baseline for updating performance measures to best position MoDOT to meet its strategic goals. In addition, building upon state and federal goals for the 2022 SFRP ensures that MoDOT meets the requirements of both the FRA for federal rail transportation funding and the FAST Act for federal freight transportation funding, and creates consistency across transportation plans.

Appendix A. Previous MoDOT Goals

A.1 2012 Missouri State Rail Plan

The 2012 State Rail Plan established six goals to help MoDOT achieve its freight and passenger rail vision for the state. These goals were developed based on select tangible results associated with MoDOT's Tracker, which identifies and monitors performance measures for developing efficient and practical transportation services. The tangible results directly related to rail transportation services include: 1) advance economic development; 2) environmentally and socially responsible; 3) efficient movement of goods; and 4) easily accessible modal choices. Using these themes as a foundation, the 2012 SRP goals were:

- Promote the efficient movement of passengers.
- Promote the efficient movement of freight.
- Encourage intermodal connectivity.
- Enhance state and local economic development
- Promote an environmentally and socially responsible rail transportation development.
- Promote safe and secure railroad operations.

A.2 2017 Missouri State Freight Plan

The 2017 State Freight Plan identified four goal areas based on feedback and engagement with the plan's steering committee and public engagement efforts as well as recent statewide and regional freight planning studies. The plan leveraged LRTP goal areas to further explore Missouri freight transportation conditions, needs, and issues. The 2017 SFP goals were:

- Maintenance: Maintain the freight system in good condition by keeping highways and bridges in good condition and supporting the maintenance of railways, waterways, airports, and multimodal connections.
- Safety: Improve safety on the freight system by decreasing the number and severity of crashes involving commercial vehicles and improving safety at railroad crossings
- Economy: Support economic growth and competitiveness in Missouri through strategic improvements to the freight system.
- Connectivity and Mobility: Improve the connectivity and mobility of the freight system by reducing congestion and increasing reliability on the roadways; by supporting improved efficiency of rails, waterways, and airports; and by improving connections between freight modes.

In addition to the system-related goals, MoDOT also established three strategic considerations that were related to the planning process, collaboration with freight stakeholders, and implementation of the Freight Plan. These strategic considerations were:

- Environmental: Reduce and/or mitigate the adverse environmental impacts of freight.
- Organizational & Process: Institute policies and practices that support the freight system, such as exploring funding flexibility and stability and using technology to improve operations on the freight system.
- Customers & Partners: Improve coordination and collaboration with freight stakeholders.

Appendix B. Review and Comparison of Existing MoDOT Freight Performance Measures

B.1 Examples of Performance Measure Categories

Table B.1 provides examples of network supply, utilization, and infrastructure performance measures.

TABLE B.1 EXAMPLES OF NETWORK SUPPLY, UTILIZATION, AND INFRASTRUCTURE CONDITION FREIGHT PERFORMANCE MEASURES

Mode	Measure
Network Supply	
Highway	Miles or lane-miles of highway by functional classification
	Miles or lane-miles of designated truck routes
Railroad	Miles of rail by carrier class
	Miles of double-tracked rail
	Number and type of rail yards
Network Utilization	
Highway	Annual or average annual daily truck traffic
	Annual or average annual daily truck miles traveled
	Annual or average annual daily truck ton-miles
Railroad	Annual or average annual daily number of trains per segment
	Annual or average annual daily number of lifts by intermodal terminal
	Annual or average annual daily train miles traveled
	Annual or average annual daily train ton-miles
Other Freight Modes	Tonnage by mode (i.e., air, water, pipeline)
	Containers by port (i.e., water)
	Landed weight of all-cargo operations (i.e., air)
Infrastructure Condition	
Highway	Percent of pavement in good condition on freight significant highways
	Number of weight restricted bridges divided by total number of bridges
	Percent of bridges that meet good and poor structural condition thresholds
Railroad	Miles of track in FRA Class I divided by total miles of Class I track
	Percent of rail track-miles with 286,000-pound railcar capacity rating
Other Freight Modes	Unscheduled lock closure time (i.e., water)

Mode	Measure
	Channel depths at the port divided by depths at competitive ports
Pipeline	Percent of pipeline by decade of installation
	Leaks per mile of pipeline

Source: FHWA, Freight Performance Measure Primer, October 2017; Georgia Transportation Institute University Transportation Center, Trucking in Georgia: Freight Performance Measures, 2011; Cambridge Systematics, Inc.

Table B.2 provides examples of travel time and congestion freight performance measures.

TABLE B.2 EXAMPLES OF TRAVEL TIME AND CONGESTION FREIGHT PERFORMANCE MEASURES

Mode	Measure
Highway	Truck Travel Time Reliability Index
	Travel Time Index (TTI) on freight-significant links (ratio of the peak travel time to free-flow travel time)
	Buffer Time Index on freight-significant links (95th percentile travel time - average travel time / average travel time)
	Planning Time Index on freight-significant links (ratio of the 95th percentile travel time to average travel time or free flow travel time)
	Percent of interstate mileage providing for reliable truck travel times
	Percent of interstate mileage that is uncongested
	Average hours of delay per day for freight vehicles on freight-significant links
Railroad	Average terminal dwell time train-hours of delay
	Railroad corridor level of service
	Average train speeds
Other Freight Modes	Gate reliability or truck turn time (i.e., air, water, and rail intermodal)
	Percent of on-time departures and arrivals at freight significant airports

Source: FHWA, Freight Performance Measure Primer, October 2017; Georgia Transportation Institute University Transportation Center, Trucking in Georgia: Freight Performance Measures, 2011; Freight Performance Measure Approaches for Bottlenecks, Arterials, and Linking Volumes to Congestion Report, 2015; Cambridge Systematics, Inc.

Table B.3 provides examples of safety freight performance measures.

TABLE B.3 EXAMPLES OF SAFETY FREIGHT PERFORMANCE MEASURES

Mode	Measure
Highway	Truck crash rate (per mile or per miles-traveled)
	Number of heavy truck-related fatalities
	Number of truck parking spaces
	Number of truck parking spaces per mile of NHS

Mode	Measure
	Number of truck parking spaces per truck VMT
Railroad	Number of highway-rail crashes
	Number of at-grade railroad crossings along freight significant corridors, i.e. freeways, interregional corridors
	Number of rail fatalities
	Train derailments per ton moved
Other Freight Modes	Value of cargo lost or damaged per ton or value of cargo moved (i.e., air, water, pipeline)
	Incidents per 1,000 operations at freight-significant airports (i.e., air)
	Annual or average annual number of incidents (i.e., air, water, pipeline)
	Annual or average annual number of excavation incidents
	Annual or average annual number of incidents per mile (i.e., pipeline)

Source: FHWA, Freight Performance Measure Primer, October 2017; Georgia Transportation Institute University Transportation Center, Trucking in Georgia: Freight Performance Measures, 2011; Cambridge Systematics, Inc.

Table B.4 provides examples of environmental freight performance measures.

TABLE B.4 EXAMPLES OF ENVIRONMENTAL FREIGHT PERFORMANCE MEASURES

Mode	Measure
All Freight Modes	Total tons of emissions reduced from Congestion Mitigation and Air Quality Improvement Program (CMAQ) projects for applicable criteria pollutants and precursors
	Pounds of greenhouse gas emissions
	Increase in energy consumed or costs related to energy consumption
	Increase in air pollution impacts/costs

Source: FHWA, Freight Performance Measure Primer, October 2017; Georgia Transportation Institute University Transportation Center, Trucking in Georgia: Freight Performance Measures, 2011; Cambridge Systematics, Inc.

Table B.5 provides examples of economic and freight demand performance measures.

TABLE B.5 INVENTORY OF COMMON ECONOMIC AND FREIGHT DEMAND PERFORMANCE MEASURES

Mode	Measure
All Freight Modes	Tonnage of freight by mode
	Value of freight by mode
	Average or total vehicle operating costs
	Indirect economic impact of an investment (e.g., changes in personal income, employment, property value, etc.) resulting from a transportation investment
	Benefit-cost ratio – direct economic impact of an investment (e.g., travel time savings, reduced vehicle operating costs, emissions reduction, etc.) resulting from a transportation investment

Source: FHWA, Freight Performance Measure Primer, October 2017; Georgia Transportation Institute University Transportation Center, Trucking in Georgia: Freight Performance Measures, 2011; Cambridge Systematics, Inc.

B.2 Review of Existing MoDOT Freight Performance Measures

What are the measures?

Freight infrastructure investment decisions in Missouri are influenced by a broad range of considerations, including MoDOT's strategic direction, system plans, and the needs and activities of MoDOT's partners in the delivery of freight infrastructure. MoDOT's Tracker is a quarterly publication of departmental performance measures that documents MoDOT's progress and includes 49 performance measures that directly link to the departments mission, values and tangible results. The 2017 State Freight Plan used the Tracker as the foundation to establish strategic performance measures used to track the efficiency of freight movement.

What data do the measures require?

The availability and quality of data to support performance measures is an important consideration. For performance measures to be useful and informative, they must be supported with correct, reliable, and consistent data. Freight data is often a challenge as they may be limited in terms of completeness, timeliness, and accuracy. This is especially true for data that is external to a transportation agency and for freight modes that are primarily privately owned. Table B.6 contains a summary of the data and sources for Missouri's freight performance measures.

TABLE B.6 DATA SOURCES FOR CURRENT FREIGHT PERFORMANCE MEASURES IN MISSOURI

Performance Measure	Data	Source
Percent of the major highways in good condition	• International Roughness Index • Rutting • Faulting • Cracking percent	MoDOT
Percent of structurally deficient deck area on NHS bridges	• Bridge condition ratings	MoDOT
Number of commercial vehicle crashes resulting in fatalities or serious injuries	• Crashes	MoDOT
Rail crossing crashes or fatalities	• Crashes • At-grade rail crossing locations	MoDOT, Federal Railroad Administration
Goods movement competitiveness	• Employment by industry sector • Gross domestic product by industry sector	Missouri Department of Economic Development
Job and economic growth by key sector (including agriculture, manufacturing and transportation/logistics)	• Employment by industry sector • Gross domestic product by industry sector	Missouri Department of Economic Development

Performance Measure	Data	Source
Freight tonnage by mode	• Commodity flows by mode	TRANSEARCH
Annual hours of truck delay	• Truck travel times	National Performance Management Research Data Set
Truck reliability index	• Truck travel times	National Performance Management Research Data Set

Four of Missouri's nine freight performance measures rely on data that is controlled by MoDOT. These include percent of major highways in good condition; percent of structurally deficient deck area on NHS bridges; number of commercial vehicle crashes resulting in fatalities or serious injuries; and rail crossing crashes or fatalities. This is the preferred scenario as it allows MoDOT more control over the factors that make data useful for performance measurement (i.e., completeness, timeliness, and accuracy).

Another four of Missouri's nine freight performance measures rely on data that is external to MoDOT but comes from public sources that produce quality data on which MoDOT can rely. These include goods movement competitiveness; job and economic growth by key sector; annual hours of truck delay; and truck reliability index. Those measures rely on data produced by the Missouri Department of Economic Development and the FHWA.

Only one of Missouri's freight performance measures relies on a private data source. The freight tonnage by mode measure uses commodity flow data produced by IHS Markit, the TRANSEARCH database. If necessary, the publicly available Freight Analysis Framework, produced by the FHWA and the Bureau of Transportation Statistics, could serve as a substitute for the TRANSEARCH data. While the FAF would allow the calculation of this measure at the statewide level, it would not provide information for individual counties as TRANSEARCH does.

How do the measures align with federal goals?

It is important that freight performance measures at the state level align with freight goals and priorities at the federal level. Under the FAST Act, state freight plans are required to support the National Multimodal Freight Policy and national freight goals. Having freight performance measures that align with national goals helps to ensure that Missouri's freight plan does indeed support national priorities.

Two federal transportation bills guide the nation's freight policy: MAP-21 and the FAST Act. MAP-21, passed in 2012, established seven national freight goal areas and required that state freight plans demonstrate consistency with these goals:

1. **Safety, Security, Resiliency.** Improve the safety, security and resilience of freight transportation.

2. **State of Good Repair.** Improve the state of good repair of the national freight network.

3. **Economic Competitiveness.** Invest in infrastructure improvements and implement operational improvements that strengthen the contribution of the national freight network to the economic competitiveness of the U.S. and that reduce congestion and increase productivity, particularly for domestic industries and businesses that create high-value jobs.

4. **Economic Efficiency.** Improve the economic efficiency of the national freight network.

5. **Advanced Technology.** Use advanced technology to improve the safety and efficiency of the national freight network.

6. **Environmental.** Reduce the environmental impacts of freight movement on the national freight network.

7. **Performance and Accountability.** Incorporate concepts of performance, innovation, competition and accountability into the operation and maintenance of the national freight network.

Subsequent to MAP-21, the FAST Act included several freight-related provisions. One provision, the establishment of a National Multimodal Freight Policy, includes national goals to guide decision-making. The goals of the National Multimodal Freight Policy are defined in 23 U.S.C. 167:

8. Invest in infrastructure improvements and implement operational improvements on the highways of the United States that

a. strengthen the contribution of the National Highway Freight Network to the economic competitiveness of the United States;

b. reduce congestion and bottlenecks on the National Highway Freight Network;

c. reduce the cost of freight transportation;

d. improve the year-round reliability of freight transportation; and

e. increase productivity, particularly for domestic industries and businesses that create high-value jobs;

9. Improve the safety, security, efficiency, and resiliency of freight transportation in rural and urban areas;

10. Improve the state of good repair of the National Highway Freight Network;

11. Use innovation and advanced technology to improve the safety, efficiency, and reliability of the National Highway Freight Network;

12. Improve the efficiency and productivity of the National Highway Freight Network;

13. Improve the flexibility of States to support multi-State corridor planning and the creation of multi-State organizations to increase the ability of States to address highway freight connectivity; and

14. Reduce the environmental impacts of freight movement on the National Highway Freight Network.

Table B.7 shows how Missouri's freight performance measures align with national freight goals.

TABLE B.7 ALIGNMENT OF 2017 MISSOURI FREIGHT PERFORMANCE MEASURES WITH NATIONAL FREIGHT GOALS

Performance Measure	Increase Contribution of the NHFN to Economic Competitiveness, Reduce Freight Congestion and Costs, Improve Freight Reliability, and Increase Economic Productivity	Improve Safety, Security, Efficiency, and Resiliency of Freight Transportation	Improve the State of Good Repair of the NHFN	Innovation and Advanced Technology to Improve the Safety, Efficiency, and Reliability of the NHFN	Improve NHFN Efficiency and Productivity	Multi-State Corridor Planning to Improve Freight Connectivity	Reduce Environmental Impacts of the NHFN
Percent of the major highways in good condition			✓				
Percent of structurally deficient deck area on NHS bridges			✓				
Number of commercial vehicle crashes resulting in fatalities or serious injuries	✓	✓		✓	✓	✓	
Rail crossing crashes or fatalities	✓	✓		✓	✓	✓	
Goods movement competitiveness	✓						
Job and economic growth by key sector (including agriculture, manufacturing and transportation/ logistics)	✓						
Freight tonnage by mode	✓				✓		
Annual hours of truck delay	✓	✓		✓	✓	✓	✓
Truck reliability index	✓	✓		✓	✓	✓	

Do the measures effectively identify freight bottlenecks?

A critical function of freight performance measures is their ability to identify freight highway bottlenecks. State DOTs must document the location of truck freight bottlenecks within the state every four years as part of their baseline performance period report to FHWA.[4] At two-year intervals within each performance period, states must describe their progress toward relief of identified bottlenecks as part of progress reporting. Truck freight bottlenecks are defined as any highway segment identified by a state DOT to have constraints that significantly impact freight mobility and reliability.[5]

The NCHRP Report 854 *Guide for Identifying, Classifying, Evaluating, and Mitigating Truck Freight Bottlenecks* and the FHWA *Truck Freight Bottleneck Reporting Guidebook* provides guidance on performance measures that can be used to identify freight highway bottlenecks. A list of potential performance measures identified by those reports as suitable for screening truck freight bottlenecks is shown in Table B.8. As suggested by those reports' findings, Missouri's annual hours of truck delay and truck reliability index measures can be used to effectively identify truck freight bottlenecks. In addition, the FHWA uses a related measure – truck delay per mile – to identify and rank national freight highway bottlenecks.[6] Missouri's measures enable easy comparisons of how individual segments in the state's roadway network perform over time and allow for selection of a subset of bottleneck locations for further analysis.

TABLE B.8 POTENTIAL PERFORMANCE MEASURES FOR SCREENING FREIGHT HIGHWAY BOTTLENECKS

Performance Measure	Description
Total delay per segment	Vehicle-hours per segment
Total delay per mile per segment	Delay per segment, normalized by segment length
Hours of delay per truck	Vehicle-hours of delay normalized by number of trucks
Frequency of congestion per segment	How often time intervals of speed data are congested
Total hours when congestion is present	Sum of time intervals meeting a congestion threshold
Truck Travel Time Reliability (TTTR)	The ratio of the 95th percentile truck travel time to the 50th percentile truck travel time
Travel Time Index	The ratio of the 95th percentile travel time to the 50th percentile travel time (reliability measure) or reference travel time (Similar to the national TTTR measure)
Planning Time Index	The ratio of the 80th percentile travel time to the 50th percentile travel time (reliability measure) or reference travel time
Planning Time Index 80th	Same as Travel Time Index except for the peak direction rather than both directions
Commuter Stress Index	Calculated as congestion delay multiplied by the value of time or by the value of excess fuel consumption

Source: NCHRP Report 854 Guide for Identifying, Classifying, Evaluating, and Mitigating Truck Freight Bottlenecks; FHWA Truck Freight Bottleneck Reporting Guidebook; Cambridge Systematics, Inc.

[4] 23 CFR 490.107(b)

[5] 23 CFR 490.101

[6] https://ops.fhwa.dot.gov/freight/freight_analysis/mobility_trends/national_list_2019.pdf

B.3 Comparison of MoDOT Freight Performance Measures to National Best Practices

A key step in developing recommended freight performance measures for Missouri is to examine notable freight performance measurement practices nationally and compare them to Missouri's practices. To identify national best practices, a number of resources were used. One resource was the National Cooperative Freight Research Program Project 3 report, *Performance Measures for Freight Transportation*, which developed a framework for measuring the performance of the freight transportation system. Another resource was the 2015 FHWA *Freight Performance Measure Approaches for Bottlenecks, Arterials, and Linking Volumes to Congestion Report*. That report identified multiple freight performance measures for identifying highway freight bottlenecks. In addition, the Federal Highway Administration's *2017 Freight Performance Measure Primer*, which provides national best practices and recommendations to create a comprehensive freight performance measurement program, was used a resource.

Besides these national studies, the Institute of Trade and Transportation Studies produced a technical memorandum that reviewed and documented current efforts of state departments of transportation to measure and monitor freight performance for the purpose of gauging the effectiveness of freight system investments. Some of the insights from that study are relevant to Missouri as it is an ITTS member state. Lastly, although there is a lack of uniformity across statewide freight performance measures, some states have been proactively developing their freight programs to be more performance-driven. These states are highlighted as examples of best practices that may be useful to Missouri as it advances its freight transportation program.

Best Practices from National Studies

Completed in 2011, NCFRP Project 3 identified freight transportation performance issues important to stakeholders and developed a framework for measuring the performance of the freight transportation system, subsystems, and components. The framework included a Freight System Report Card which included 28 recommended performance measures (see Table B.9) across 6 performance categories. Those categories included:

- Freight Demand – These measures provide insight into the past and future volumes on the freight system;
- Freight Efficiency – Efficiency measures reflect the ease or difficulty with which goods move on the freight system;
- Freight System Condition Indicators – These measures reflect the state of repair of the freight system;
- Freight Environmental – Environmental measures capture the contribution of freight activity to emissions;
- Freight Safety – Safety measures capture the frequency and severity of incidents involving freight vehicles; and
- Freight Investment – These measures relate to the level of investment necessary to maintain the freight system in terms of its condition and performance.

TABLE B.9 NCFRP PROGRAM REPORT 10 FREIGHT PERFORMANCE MEASURES

Category	Performance Measure
Freight Demand	• Freight Volumes (tons), All Modes • Truck Freight Volumes (tons) • Rail Freight Volumes (tons) • Inland Water Freight (tons) • Containerized Imports/Exports (Loaded TEUs)
Freight Efficiency	• Interstate Highway Speeds • Interstate Highway Reliability Measure • Top Interstate Bottleneck Rankings • Composite Class I Railroad Operating Speed • Rail Freight Market Share of Ton-Miles • Logistics as a Percentage of Gross Domestic Product
Freight System Condition Indicators	• NHS Bridge Structural Deficiencies • NHS Pavement Conditions
Freight Environmental	• Truck Emissions (Overall Emissions) • Particulate Emissions • Truck NO_x Emissions • Volatile Organic Compounds (VOC) Emissions • Greenhouse Emissions • Rail-Produced Greenhouse Gas Emissions • Water-Produced Greenhouse Gas Emissions • Rail VOC and NO_x Emissions • Ship NO_x Emissions
Freight Safety	• Truck Injury and Fatal Crash Rates • Highway Rail At-Grade Incidents
Freight Investment	• Investment to Sustain NHS • Rail Industry Cost of Capital • Estimated Capital to Sustain Rail Market Share • Investment to Sustain Inland Waterway System

Source: Transportation Research Board, National Cooperative Freight Research Program Report 10: Performance Measures for Freight Transportation, 2011.

The 2015 FHWA *Freight Performance Measure Approaches for Bottlenecks, Arterials, and Linking Volumes to Congestion Report* identified multiple freight performance measures for identifying highway freight bottlenecks (see Table B.10). As the focus of this report was on highway freight bottlenecks, the performance measures it recommended were limited to travel time and congestion measures as defined in Section 3.1 of this technical memorandum. Despite this limitation, the report's recommendations are still useful to MoDOT as the majority state DOT's funding and strategic focus is on the highway system. Both first and second order freight performance measures are included in the *Freight Performance Measure Approaches for Bottlenecks, Arterials, and Linking*

Volumes to Congestion Report. Whereas first order performance measures are those that directly measure a change in performance (e.g., an increase or decrease in crashes), second order performance measures are those that emerge as a direct result of those changes (e.g., monetized value of an increase or decrease in crashes).

TABLE B.10 BOTTLENECK PERFORMANCE MEASURES

Performance Measure	Description
Total Delay	Actual vehicle-hours (or person-hours) experienced in the highway section minus the vehicle-hours (or person-hours) that would be experienced at the reference speed. Total delay is only possible to compute if traffic volumes have been integrated. If not, unit delay (delay per vehicle) is substituted.
Mean Travel Time Index (MTTI)	The mean travel time over the highway section divided by the travel time that would occur at the reference speed.
Planning Time Index (PTI)	The 95th percentile Travel-Time Index computed as the 95th percentile travel time divided by the travel time that would occur at the reference speed.
80th Percentile Travel Time Index (P80TTI)	The 80th percentile Travel-Time Index computed as the 80th percentile travel time divided by the travel time that would occur at the reference speed.
Hours of Congestion per Year	Number of hours where vehicle speeds are below defined thresholds by functional class (e.g., 50 miles per hour for freeways and multi-lane expressways).
95th Percentile Queue Length	The highway distance where the speeds of contiguous segments upstream of an identified bottleneck location are less than 15 miles per hour for signalized highways and 30 miles per hour for freeways, multi-lane, and two-lane highways.
Average Queue Length	The average highway distance where the speeds of contiguous segments upstream of an identified bottleneck location are less than 15 miles per hour for signalized highways and 30 miles per hour for freeways, multi-lane, and two-lane highways.
Delay Cost	This is the monetized value of delay. It is a function of total delay, vehicle occupancy, and value of time.
Fuel Cost	This is the added cost of fuel due to experiencing delay. It is a function of total delay, average speed, average fuel economy of passenger and commercial vehicles, and average diesel and gasoline costs.

Source: FHWA, Freight Performance Measure Approaches for Bottlenecks, Arterials, and Linking Volumes to Congestion Report, 2015.

The FHWA's *2017 Freight Performance Measure Primer* observed that the aim of most DOTs and MPOs is to increase infrastructure efficiency through focused investments. As a result, freight performance measures must be able to predict the impact of investment on transportation flows through the state or region. To achieve this, performance measures for multiple modes are necessary. Furthermore, they must be supported with data relating each of the major policy goals for freight by mode. Recommended freight performance measures for states and MPOs to include in their freight plans from the *2017 Freight Performance Measure Primer* are shown in Table B.11.

TABLE B.11 FHWA FREIGHT PERFORMANCE MEASURES PRIMER RECOMMENDED MEASURES

Performance Area	Mode	Performance Measure
Safety	Highway	• Motor carrier crash rate • Motor carrier truck at-fault rate • Number of heavy truck-related fatalities

Performance Area	Mode	Performance Measure
		• Capacity of weight stations (number of trucks processed per hour) • National Highway System (NHS) pavement conditions • NHS bridge conditions • NHS intermodal connector condition • Total cost of freight loss and damage from accidents per vehicle miles traveled (VMT)
	Rail	• Total loss and damage from accidents per route-mile • Total loss and damage from accidents per tons moved • Number of at-grade railroad crossings along freight-significant corridors such as freeways and interregional corridors • Number of rail fatalities • Train derailments per ton moved
	Water	• Value of cargo lost or damaged per tons or value of cargo moved • Containers damaged or lost per containers handled/total containers
	Air	• Total loss and damage from accidents divided by value of freight • Percent of study airports meeting Traffic Safety Administration guidelines for general aviation security • Incidents per 1,000 operations at freight-significant airports
Maintenance and Preservation	Highway	• Percent of pavement in good condition on freight-significant highways • Number of weight-restricted bridges per total number of bridges • Percent of bridges that meet good and poor structural condition thresholds • Service life remaining on highway pavement • Benefit of truck weight enforcement on pavement service life
	Rail	• Miles of track in excepted or Federal Railroad Administration Class I divided by total miles of Class I track • Number of double-stack tunnel restrictions per number of tunnels
	Water	• Percent of tons of freight moving through constrained locks • Unscheduled lock closure time (hours) • Channel depths at the port divided by depths at competitive ports
	Air	• Percent of pavement in fair or poor condition at freight-significant airports
Mobility, Reliability, and Congestion	Highway	• Percent of interstate providing reliable travel times • Percent of interstate where peak hour travel times meet expectations • Percent of non-interstate NHS providing reliable travel times • Percent of non-interstate NHS where peak hour travel times meet expectations • Annual hours of excessive delay per capita • Urban: Average hours of delay per day for freight vehicles on freight-significant links

Performance Area	Mode	Performance Measure
		• Urban: Travel Time Index (TTI) on freight-significant links (ratio of the peak travel time to free-flow travel time) • Percent of interstate mileage that is uncongested • Clearance time for incidents, crashes, or hazardous materials • Number of intersections and ramps with inadequate turning radii for large trailers on freight-significant corridors • Urban: Buffer index on freight-significant links (ratio of the 95th percentile travel time to average travel time) • Rural: Average hours of delay per day for freight vehicles on freight-significant links • Number of truck rest areas and their capacities • Rural: Average travel time on freight-significant links
	Rail	• Tons or ton-miles of freight over relevant period • Average terminal dwell time train-hours of delay • Percent of rail track-miles with 286,000-pound railcar capacity rating • Railroad corridor level of service
	Water	• Tons of traffic arriving at a port • Twenty-Foot Equivalent Units (TEUs) passing through port (port throughput) • Gate reliability or truck turn time • Ship unload rate (time per container) • Ship load rate (time per container) • Average delay per barge tow on river
	Air	• Flight frequency by airlines with cargo capacity (number per day) • Average time between flights by airlines with cargo capacity (minutes) • Percent of on-time departures at freight-significant airports • Percent of on-time arrivals at freight-significant airports
Accessibility and Connectivity	Highway	• Triple trailer VMT as a percent of total freight VMT • Percent of major generators with appropriate roadway access to interregional corridors and major highways • Percent of shippers with access to triple network
	Rail	• Class I: Ratio of unit train carloads (or tons) per total carloads (or tons) • Percent of shippers within 50 miles of intermodal trailer-on-freight-car (TOFC) facility • Percent of major freight generators with appropriate rail access • Number or capacity of intermodal facilities
	Water	• Shippers within 50 miles of river port (for barge accessibility) • Availability of container-handling capability and/or bulk transfer capability
	Air	• Flight frequency by airlines with cargo capacity (number per day) • Average time between flights by airlines with cargo capacity (minutes)

Performance Area	Mode	Performance Measure
		• Average travel time delay for trucks on airport access roads • Number of docks or acres of cargo-handling facilities
Environmental	All Modes	• Total tons of emissions reduced from Congestion Mitigation and Air Quality Improvement Program (CMAQ) projects for applicable criteria pollutants and precursors • Pounds of greenhouse gas emissions • Increase in energy consumed or costs to energy consumption • Increase in air pollution impacts/costs

Source: FHWA, 2017 Freight Performance Measure Primer.

Insights from the Institute of Trade and Transportation Studies

The Institute for Trade and Transportation Studies is a multi-state coalition funded by USDOT and ITTS member state departments of transportation. The current ITTS state membership consists of the State DOTs from the following States: Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, Missouri, South Carolina, Texas, and Virginia. The ITTS fosters regional collaboration among its members and provides research concerning freight trends and freight planning, develops freight planning tools and procedures, and develops collaborative relationships with relevant organizations and stakeholders.

Recently, as part of a broader initiative on freight performance management, the ITTS performed interviews with its member states in order to better understand the actions they are taking to measure and monitor the performance of freight system investments. The focus of the interviews was on understanding the scope of freight performance measure programs, the challenges related to measuring and monitoring performance, and identifying actions that states may take to improve freight performance management. Some of the overarching themes from those interviews is summarized below:

- Scope of Freight Performance Management Programs

  » Though other freight modes are included, highway is the predominant mode over which ITTS states measure performance. This is due to multiple factors including the fact that most state DOTs have limited ownership of non-highway freight modes and that the federal mandate for state DOTs regarding freight performance measurement and reporting focuses on the Interstate highway system. Nevertheless, states articulated the importance of measuring performance across the entire multimodal freight network.

  » The federally mandated freight performance measure, Truck Travel Time Reliability Index, was the measure most consistently calculated and tracked by ITTS member states. Other freight performance measures reported by member states include pavement and bridge conditions, travel time reliability, truck crashes, highway-rail crashes, and freight tonnage by mode, among others.

- Common Challenges

  » ITTS member states identified multiple challenges to measuring the impacts of freight system investments and freight performance management generally. Challenges related to the availability, quality, completeness,

and timeliness of data were common. Travel time data was specifically identified as a challenge area as publicly available travel time data sets often do not provide coverage for the entirety of the state-maintained system. This is especially true for states with large state-maintained systems relative to their geographic size. In addition, these data sets often do not have as accurate cross section information (e.g., number of lanes, direction of travel, etc.) as state roadway linear reference systems. Furthermore, travel time data must be conflated with other roadway linear reference system data (such as annual average daily truck traffic, number of lanes, etc.) to develop more meaningful analyses, which is a challenge.

» Other data-related challenges centered on the difficulty in obtaining data for non-highway freight modes, especially those modes that are primarily private such as railroads. Data challenges are generally more pronounced for data that must be sourced externally as opposed to internally. However, even internal freight data has its challenges, with the accuracy of crash records involving trucks and the quantity and spatial distribution of classification count stations being cited as examples.

- Improving Freight Performance Management

» Improved freight data was viewed as critical to improving freight performance management. This includes both internal data, such as classification counts, and external data, such as truck travel times. Furthermore, ITTS member states stressed the importance of internal collaboration and data sharing across modal divisions for better implementation of performance management practices.

» ITTS member states stressed the importance of leading with data in deciding which performance measures are calculated and tracked. Some data challenges to freight performance management can be alleviated if DOTs align performance measures with those data sources over which they have the most control and confidence. States also emphasized the need to highlight performance measures that resonate with decision-makers and the public. Performance measures that capture the public's decision-makers' attention are important for making the business case for freight.

States Exhibiting Best Practices

In addition to best practices recommended from national studies, there are a number of states that have taken steps to advance their freight performance management programs. This section of the report highlights states that serve as examples of best practices that may be useful to Missouri as it advances its freight transportation program.

Florida

Florida's Freight Mobility and Trade Plan tracks multiple performance measures across surface freight modes (i.e., highway, rail, water, and air freight). [7] As shown in Table B.12, the Florida Department of Transportation describes their freight performance measures across three dimensions:

- Quantity - How much freight is moved;

[7] https://www.fdot.gov/rail/plandevel/freight-mobility-and-trade-plan

- Quality – How good or bad the travel experience is; and
- Utilization – How much of the transportation system is used/available.

The measures adopted as part of the 2020 Freight Mobility and Trade Plan include truck miles traveled, truck delay, rail tonnage, rail crashes, and seaport tonnage, among others. Although all surface modes are covered, highway is the predominant mode over which the state tracks its freight performance.

TABLE B.12 FDOT FREIGHT PERFORMANCE MEASURES

Mode	Quantity	Quality	Utilization
Highway	• Truck Miles Traveled • Combination Truck Miles Traveled • Combination Truck Ton Miles	• Combination Truck On-Time Arrival • Combination Truck Planning Time Index • Combination Truck Hours of Delay • Truck Bottlenecks • Percent of travel meeting Level of Service • Highway Pavement Conditions • Bridge Conditions • Highway (Truck) Safety	• Truck Empty Backhaul • Truck Parking Utilization
Rail	• Rail Tonnage	• Rail Crashes	
Water	• Seaport Tonnage		
Aviation	• Aviation Tonnage	• Aviation Departure Reliability	

Source: FDOT, Freight Mobility and Trade Plan, Technical Memorandum 1: Policies, Performance Measures, and Outreach, April 2020.

A notable practice is that in addition to tracking performance, FDOT estimates the impact of freight investments. Specifically, FDOT uses the Florida Freight Transportation Economic Impact Kit to measure the economic impact of freight and other transportation investments. The FTEIK combines a regional economic input-output model with the freight component of the state's travel demand model (i.e., Freight Supply-chain Intermodal Model or FreightSIM). Outputs from FreightSIM, changes in freight vehicle miles traveled and vehicle hours traveled, are converted into monetary values that are the inputs for the regional economic input-output model. The input-output model is then used to estimate economic impacts by industry sector.

Maryland

In 2017, the Maryland Department of Transportation Office of Freight and Multimodalism developed the Strategic Goods Movement Plan to guide planning, programming, and policy positions based on qualitative and quantitative analyses. This five-year plan analyzed trends and long-range projects developed from multiple stakeholders and the Freight Stakeholder Advisory Committee. The Freight Stakeholder Advisory Committee consisted of freight

stakeholders from the private sector, the FHWA, the FRA, and the public sector who assisted with identifying freight movement challenges and outcomes to improve safety and efficiency of freight movement in the state.

TABLE B.13 MDOT FREIGHT PERFORMANCE MEASURES

Performance Area	Freight Performance Measure
Quality of Service – Highway	• Truck congestion cost on freeways/expressways in the Baltimore/Washington region • Amount of delay for trucks due to congestion on freeways/expressways • Wasted fuel for trucks • Truck user cost savings due to recurring congestion relief projects on State highways • Percentage of the Maryland State Highway Administration network in overall preferred maintenance condition • Average truck turnaround time at Seagirt Marine Terminal
Safety and Security – Highway	• Number of fatalities in traffic crashes involving heavy trucks on all roads in Maryland • Number of persons injured in traffic crashes involving heavy trucks on all roads in Maryland • Annual number of commercial vehicle safety inspections performed • Number of available truck parking spaces • Peak overnight truck parking volume
Safety and Security – Rail	• Number of non-fatal crashes at at-grade rail crossings • Number of fatal crashes at at-grade rail crossings • Number of public and private at-grade highway-rail crossings • Number of hazardous materials release incidents
Safety and Security – Marine	• Maryland Port Authority compliance with the Maritime Transportation Security Act of 2002
System Preservation and Performance – Highway	• Number or percent of bridges that are structurally deficient • Percent of roadway miles with acceptable ride quality • Weighed vehicles found to be overweight
System Preservation and Performance – Marine	• Dredge material placement capacity remaining for Harbor and Bay sections
Economic Prosperity – Rail	• Number of short line carloads on Maryland owned rail
Economic Prosperity – Marine	• Port of Baltimore foreign cargo • Maryland Port Authority general cargo tonnage
Economic Prosperity – Air	• Total air tonnage at BWI/Marshall Airport • Number of nonstop airline markets served by BWI/Marshall
Environmental Stewardship – Marine	• Mid-Atlantic Dray Truck Replacement Program • Acres of wetlands and wildlife habitat created, restored, or improved since 2000
Community Vitality	• Intermodal containers moved by rail through the Port of Baltimore • Domestic intermodal containers moved by rail

Source: Maryland Department of Transportation, Strategic Goods Movement Plan, 2017.

Ohio

The Ohio Department of Transportation updated its Transport Ohio Statewide Freight Plan in 2019 for the purpose of planning and prioritizing future strategic freight system investments. At its core, the 2019 Transport Ohio Statewide Freight Plan answers the question: How can Ohio make smart transportation improvements to reduce business costs, improve freight movement connectivity, reliability, and access to local, regional and far flung international markets? Multiple freight performance measures were recommended as part of the plan and are shown in Table B.14.

TABLE B.14 ODOT FREIGHT PERFORMANCE MEASURES

Performance Area	Freight Performance Measure
Economic Development Mobility and Efficiency	• Travel time reliability index • Snow and ice control
Safety	• Annual number of crashes • Annual number of serious injuries • Annual number of fatalities
Preservation	• Percentage of roads on State Freight System with acceptable pavement condition ratings • Percentage of bridges on the State Freight System with acceptable general appraisal condition ratings
Accessibility and Connectivity	• Percentage of the highway component of the State Freight System covered by ODOT's ITS and displayed on OHGO.com
Accountability	• Percentage of Ohio MPOs and RTPOs that incorporate performance-based planning into their long-range plans
Economic Development	• Amount of non-ODOT investment capital leveraged • Number of approved and delivered economic development projects per year • Percentage of economic development projects delivered on time
Stewardship	• Total amount of Diesel Emission Reduction Grants awarded annually • Percentage of DERG projects complete within 24 months of award

Source: Ohio Department of Transportation, Transport Ohio Statewide Freight Plan, 2019.

Washington

The Washington State Department of Transportation established freight performance measures as part of the 2017 Washington State Freight System Plan (see Table B.15). WSDOT's freight performance measures are focused to support a short list of performance goals that matter most to the state's freight stakeholders. They are also specific and limited to areas where data exists and applied to freight systems the state can control or influence. Several of these measures are tracked in the Gray Notebook, WSDOT's quarterly performance and accountability report.

TABLE B.15 WSDOT FREIGHT PERFORMANCE MEASURES

Mode	Freight Performance Measure
Highway	• Average Daily Truck Volumes at Key High-Volume Segments • Annual Border Crossings by Truck • Truck Travel Time Reliability
Rail	• Annual Rail Tonnage • Annual Rail Value • Commodities Hauled • Biennial Number of Loan and Grant Projects Awarded
Water	• Annual Waterborne Freight Tonnage
Aviation	• Annual Air Cargo Tonnage • Annual Air Cargo Value

Source: WSDOT, 2017 Washington State Freight System Plan, Technical Update to the 2014 Freight Mobility Plan.

In addition, WSDOT is considering implementing the following highway freight performance measures in the future:

- Total delay: Total delay is defined as travel time divided by the congestion threshold in units of vehicle hours for trucks. This measure is based on travel time and integrates truck volume and the target set by various state agencies, MPOs, and research organizations to measure congestion.

- Hours of annual congestion: Annual congested hours are calculated as the number of hours where truck speeds are below a specified congestion threshold.

- Delay cost: Delay cost is the monetized value of truck delay and can be calculated as annual truck hours of delay multiplied by the value of truck time. This is a second order performance measure directly resulting from changes in congestion and commonly used for evaluating the impact of bottlenecks and quantifying the potential benefits of improving them.

Minnesota

The 2018 Minnesota Statewide Freight System and Investment Plan documents freight performance measures for the state. To develop the measures, the Minnesota Department of Transportation employed a Performance Measures Ad Hoc Working Group comprised of performance measure experts from MnDOT and other agencies. That group reviewed and recommended highway focused freight performance measures and indicators as shown in Table B.16. As documented in the supplemental Technical Memo – Freight Performance Measures[8], the working group focused on developing measures that help them 1) understand the system through a "freight lens," and 2) build freight performance measures around what MnDOT currently tracks. The concept of the "freight lens" reflects that by parsing out routes or roadway segments where freight activity is high (e.g., on the designated Minnesota

[8] MnDOT, "Technical Memo – Freight Performance Measures," https://www.dot.state.mn.us/planning/freightplan/pdf/4-1techmemo.pdf, accessed June 2, 2021.

Principal Freight Network), a better understanding of system condition and performance for freight may be understood (as compared to application of the measure at the state-level or to all roadways/facilities).

TABLE B.16 MNDOT FREIGHT PERFORMANCE MEASURES

Performance Area	Mode	Freight Performance Measure
Safety	Truck	Number of Fatalities
	Truck	Fatality Rate
	Truck	Number of Serious Injuries
	Truck	Serious Injury Rate
	Truck	Severe Crashes Involving Trucks
	Truck, Rail	Incidents at Highway/Railroad Crossings
Asset Management	Truck	Interstate Pavement in Good and Poor Condition based on MnDOT's Ride Quality Index (RQI)
	Truck	Non-Interstate National Highway System Pavement in Good and Poor Condition based on MnDOT's Ride Quality Index (RQI)
	Truck	Percent of Deck Area on Structurally Deficient Bridges
	Truck	NHS Bridges in Good, Fair and Poor Condition based on Deck Area
State Highway Operations	Truck	Annual Hours of Truck Delay (AHTD)
	Truck	Truck Reliability Index (RI_{80})
Freight Indicators	Truck, Rail, Water, Air, Pipeline	Total domestic shipments to, from or between Minnesota locations
	Truck, Rail, Water, Air, Pipeline	Freight by Mode (tons)
	Truck, Rail, Water, Air, Pipeline	Freight by Mode (value)
	Truck, Rail	Freight by Mode (ton-miles)
	Truck	Heavy Commercial Vehicle Miles Traveled
	Truck	Heavy Commercial Average Annual Daily Traffic (HCAADT) by Corridor
	Rail	Annual Rail Shipments (tons)
	Rail	Annual Container Lifts in Twin Cities (number)
	Water	Annual Port Shipment Tonnage

Source: MNDOT, Minnesota Statewide Freight System and Investment Plan, January 2018.

Texas

The Texas Department of Transportation identified performance measures based on stakeholder input (gathered from the workshops conducted as part of the 2018 Texas Freight Mobility Plan) and best practices from around the U.S. The performance measures were developed to be closely integrated with the Freight Plan's goals and objectives to monitor system performance and implementation progress. They were also developed to serve three key functions:

- Plan Development: Provide a method to quantify baseline system performance and the impacts of the TFMP's options to support trade-off decisions and to communicate the anticipated impacts of different investment strategies.

- Plan Implementation: Support the implementation of the TFMP by emphasizing agency goals/objectives and integrating those into budgeting, program structure, project selection and project/program implementation policies.

- Accountability: Facilitate tracking and reporting on system performance relative to the goals and objectives of the TFMP to support accountability for implementation and results.

TABLE B.17 TXDOT FREIGHT PERFORMANCE MEASURES

Performance Area	Freight Performance Measure
Safety	• Truck-related crashes per truck-miles traveled on the Texas Highway Freight Network • Percent of all fatal motor vehicle crashes involving trucks on the Texas Highway Freight Network • Number of rail-related crashes • Number of at-grade highway/rail crossing closures or grade separations • Truck-related fatalities per truck-miles traveled on the Texas Highway Freight Network • Number of injuries and fatalities from rail related crashes • Number of crashes at at-grade highway/rail crossings
Asset Preservation and Utilization	• Percent of pavement lane-miles in good repair on the Texas Highway Freight Network • Number of load restricted bridges on the Texas Highway Freight Network • Percent of bridges with vertical clearance less than 16.5 feet on the Texas Highway Freight Network • Percent of bridges in poor condition on the Texas Highway Freight Network
Multimodal Connectivity	• Number of airport cargo-access issues addressed • Number of port-access issues addressed • Volume of international cross-border freight moved by rail • Percent of intermodal connectors in fair or better pavement condition
Mobility and Reliability	• Annual hours of truck delay on the Texas Highway Freight Network • Number of projects addressing freight bottlenecks on the Texas Highway Freight Network annually • Reduction in average wait times at international commercial border crossings • Truck Travel Time Reliability index on the Texas Highway Freight Network • Percent of lane-miles at a level-of-service D or higher on the Texas Highway Freight Network • Incident clearance time on the Texas Highway Freight Network
Customer Service	• Completion of annual freight project prioritization • Number of workshops/meetings held with non-TxDOT agencies responsible for freight system investment • Completion of annual update of educational materials related to freight by TxDOT • Percent completion of annual meetings with each TxDOT district and department
Stewardship	• Percent of design projects on the Texas Highway Freight Network delivered on time and within budget

Performance Area	Freight Performance Measure
	• Percent of construction projects completed on the Texas Highway Freight Network delivered on time and within budget

Source: TxDOT, Texas Freight Mobility Plan, 2018.

How do Missouri's freight performance measures compare to best practices?

Missouri's freight performance measurement program is fairly expansive as Tracker, the state's performance management dashboard, features 49 performance measures directly linked to MoDOT's mission, values, and tangible results. Furthermore, MoDOT has generally focused its performance management program on measures that could be readily tracked with available data. As a result, Missouri already employs many of the best practices identified from national studies and other states with proactive freight transportation programs.

Aspects of Missouri's freight performance measurement program that represent best practices include the following:

- **Coverage Across Multiple Performance Areas.** A common theme across the literature was the designation of measures across demand, maintenance/asset preservation, mobility and reliability, safety, economic, and environmental performance areas. Nearly all of those areas are covered in some form by MoDOT's existing freight performance measures. Only the freight environmental performance area is not covered by Missouri's existing measures.

- **Effectively Identify Freight Bottlenecks.** Missouri's freight performance measures are effective in identifying freight bottlenecks, which is required of state DOTs by federal regulation.[9] Freight bottlenecks are any point on the network at which freight traffic flows are impeded. They can be due to physical (e.g., a lane reduction) or operational (e.g., heavy volumes) constraints. Specifically, Missouri's annual hours of truck delay and truck reliability index measures can be used to identify highway freight bottlenecks as they reveal the locations on the state's network at which truck traffic flows are impeded. These measures have been identified by national studies as being effective at identifying truck freight bottlenecks.

- **Supported by Data.** Another common theme across the freight performance literature was the importance of selecting measures that are supported by high-quality data that is consistently available. For performance measures to be useful and informative, they must be supported with correct, reliable, and consistent data. Freight data is often a challenge as they may be limited in terms of completeness, timeliness, and accuracy. One strategy that state DOTs use to address this challenge is to use internal as opposed to external data sources to support performance measures. Nearly all of Missouri's freight performance measures rely on internal data sources. Those that do not use data from reliable external sources, such as FHWA.

- **Alignment with National Goals.** It is important that freight performance measures at the state level align with freight goals and priorities at the federal level. Under the FAST Act, state freight plans are required to

[9] 23 CFR 490.107(b)

support the National Multimodal Freight Policy and national freight goals. As discussed in Section 3.3, Missouri's freight performance measures fully align with national freight goals.