

Appendix B

Trends, Needs, and Issues

Appendix B: Trends, Needs, and Issues

Introduction

This technical memorandum explores trends and needs impacting the freight system in Missouri.

As Missouri's population and demand for goods continue to increase, the transportation of products into the state will increase. Likewise, the production of goods within the State will continue to be demanded by people in other states requiring goods to be transported out of or within Missouri. As a result, the freight transportation system (whether highway, rail, water, air and pipeline) will be expected to keep up with the increase in freight traffic. In order to do this, the freight systems will need to be maintained and potentially expanded to meet the growing demand.

All modes of freight transportation--highway, rail, air, water, and pipeline—were considered in identifying trends and issues. The discussion encompasses which freight commodities are increasing or decreasing in, out, through, and within Missouri and which mode those commodities are anticipated to use.

Information from a number of sources was gathered to identify needs and issues including: MoDOT's recently completed Long Range Transportation Plan, regional freight plans, stakeholder input, freight transportation system assets inventory and assessment, and analysis of the conditions and performance of the State's freight system.

Trends and Issues

This section identifies and explores significant trends and issues impacting the freight system in Missouri today and in the future.

Freight movement provides many economic benefits to Missouri ranging from the outbound shipment of agricultural products and the inbound shipment of manufacturing parts, to finished products shipped both into and out of the State, to consumer goods used every day by Missouri families. The economic vitality of the State relies on transportation of goods into, out of, within and to a lesser extent through Missouri to support jobs and growth.

Freight Transportation Assets

Appendix A, Assets and Freight Flow Technical Memorandum, documents the transportation assets by which freight travels within, in, out, and through Missouri. The goal of the assets inventory was to identify the freight assets utilized and projected to be utilized within Missouri, so MoDOT can verify the capabilities of their freight infrastructure. The objective of the analysis is ultimately to identify freight system needs, potential capital improvements, and policy options to maintain and improve operations of the system. The inventory is discussed based on the modes by which freight travels in Missouri, as well as intermodal facilities and freight generators. Additional information on Missouri's freight assets is located in Appendix A.

Highway

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Missouri has the seventh largest state highway system in the United States. It is made up of 33,700 centerline miles of roadway and over 10,000 bridges, 5,500 miles of which are classified as heavily traveled “major highways” and 28,200 miles of which are defined as lesser traveled “minor highways”. Missouri’s major highways encompass just 20 percent of the State’s highway miles but carry 80 percent of the system’s traffic.

Rail

The state of Missouri has a significant freight rail infrastructure with six Class I freight railroads currently operating 4,200 miles of main track rail lines, 2,500 yard track miles, and 5,700 public and private rail-highway crossings within the State. There are no Class II railroads operating in Missouri; however, there are five short line railroads that serve Missouri. A railroad with operating revenues greater than \$433.2 million¹ for at least three consecutive years is considered a Class I railroad. Similarly, a railroad with revenues greater than \$34.7 million², but less than \$433.2 million³, is considered a Class II railroad; such railroads are commonly referred to as “regional” railroads. A railroad not within the Class I or II categories is considered a Class III railroad, also known as a “short line.”

¹ http://www.aslrra.org/about_aslrra/faqs/

² http://www.aslrra.org/about_aslrra/faqs/

³ http://www.aslrra.org/about_aslrra/faqs/

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Water

Missouri contains 1,050 miles of navigable rivers, including 500 miles of the Mississippi River and 550 miles of the Missouri River. A total of 14 public ports and over 200 private ports can be found along Missouri's waterways. Three public ports and over 50 private ports operate along the Missouri River; 11 public port authorities and over 150 private ports operate on the Mississippi River.

Air

Missouri is home to three of the top 106 cargo airports in North America in terms of total tonnage in 2012; these are Kansas City International Airport (MCI), Lambert-St. Louis International Airport (STL), and Springfield-Branson National Airport (SGF).

Pipeline

Approximately 10,700 miles of pipelines move natural gas, crude oil, and petroleum products throughout Missouri.

Intermodal Facilities

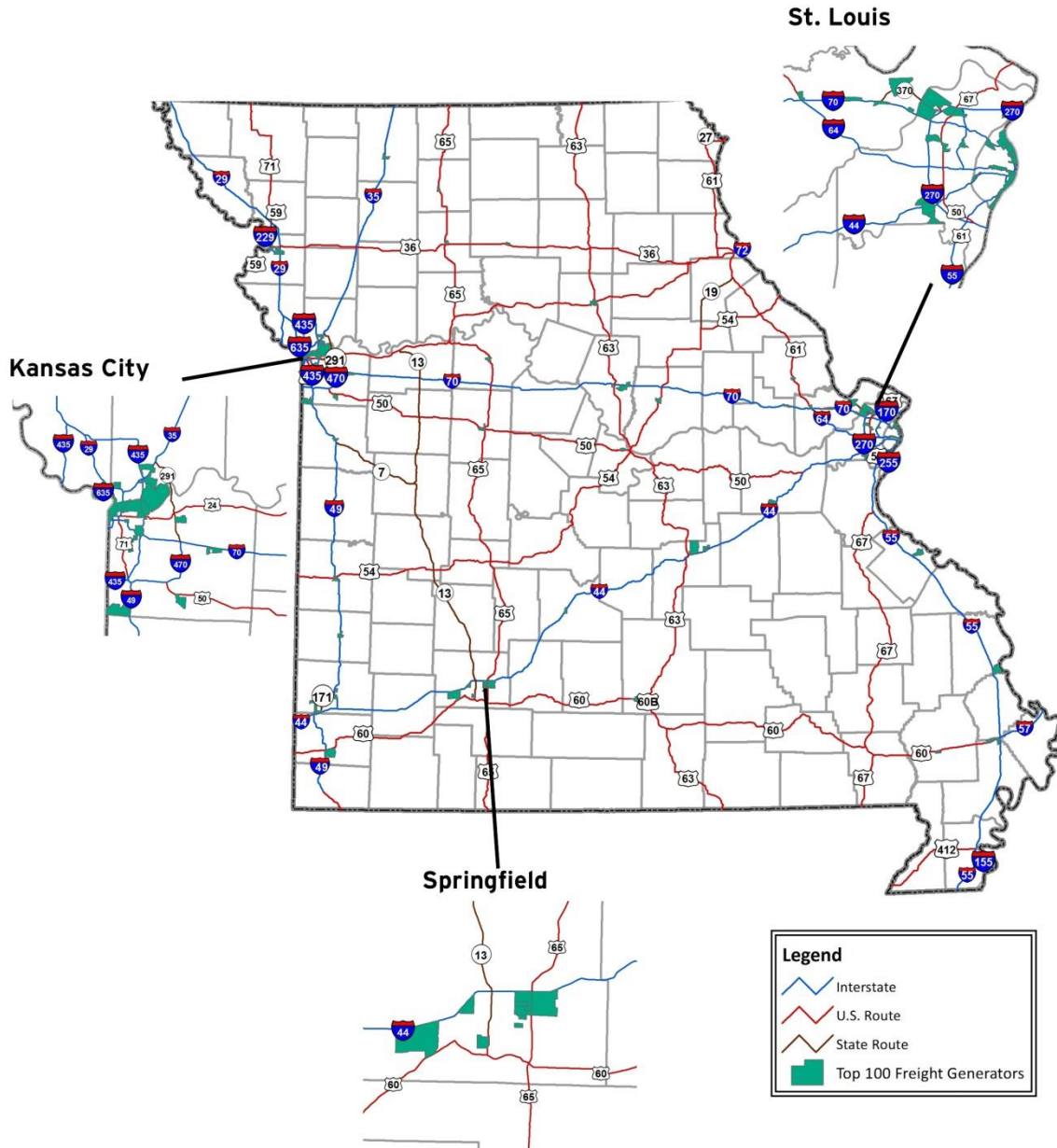
The National Transportation Atlas Data available through the Bureau of Transportation Statistics identified 115 intermodal facilities located in Missouri that provide a variety of intermodal interactions. The majority of the intermodal facilities (71%) accommodate rail – truck commodity transfers followed by modal transfers at ports (16%) and airports (8%).

Freight Generators

An analysis using GPS truck data and GIS data layers identified the top 100 most intense freight generators in Missouri. **Figure B-1** shows the location of these freight generators.

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Figure B-1: 100 Identified Freight Generators: Census Block Groups



Source: ATRI

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Condition and Performance of Freight System

Knowledge of the condition and the resulting performance of freight transport on the existing infrastructure serves to identify and aid in prioritizing freight system improvements. Appendix A also discussed the condition and performance of the highway and rail modes of freight transportation.

Condition

There are a total of 73 low vertical clearance bridges in Missouri. This represents less than one percent of all bridges owned by MoDOT. Five (four percent) of these bridges cross Interstates and 12 (nine percent) cross U.S. Highways

In addition, to the low clearance bridges there are 4,849 load-restricted bridges in Missouri. This is about 20 percent of all bridges owned by MoDOT. One hundred thirty-five (three percent) of these bridges cross Interstates and 81 (two percent) cross U.S. Highways.

Performance

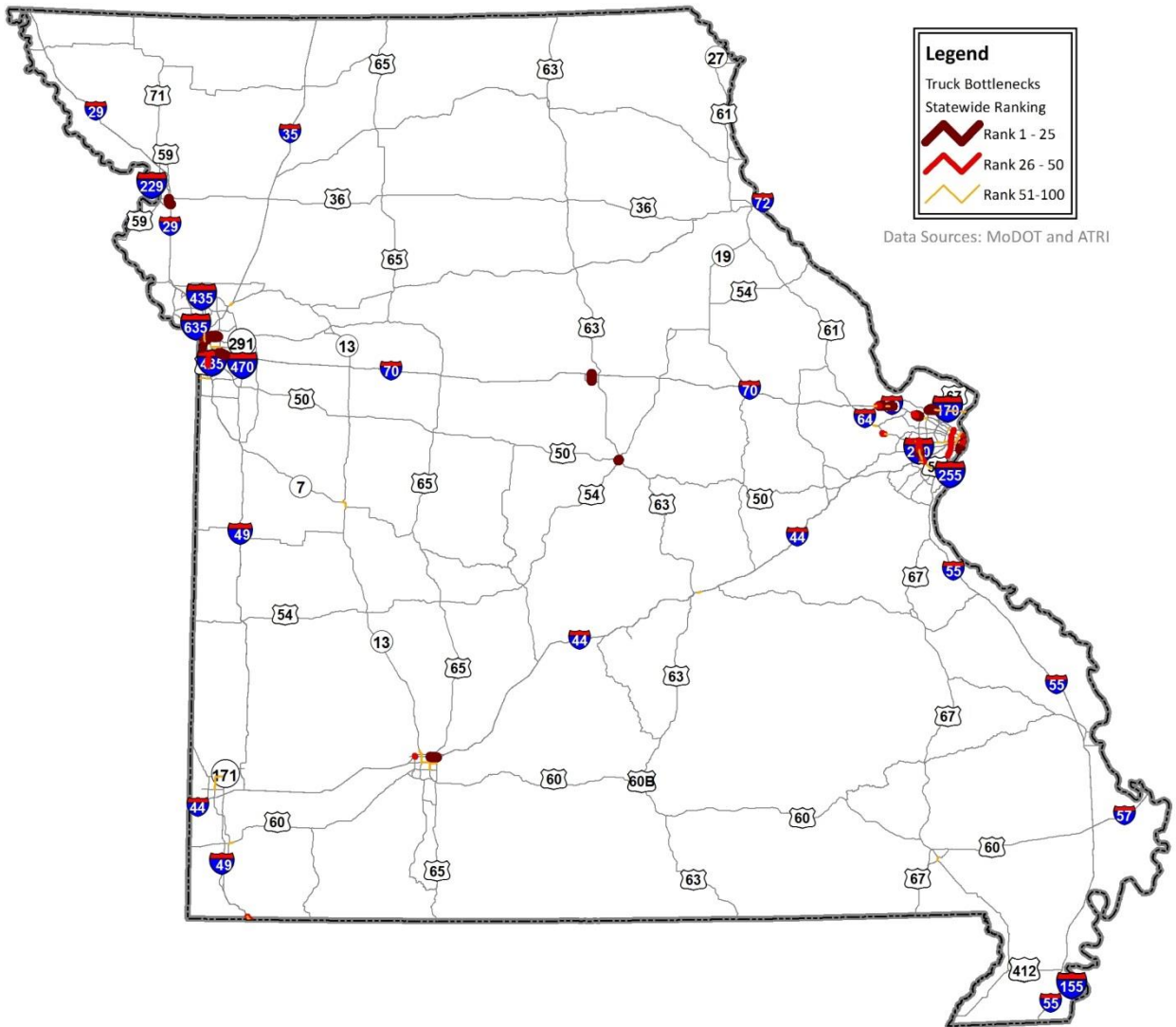
An analysis was completed to identify both highway and rail bottlenecks in the State. ATRI's (American Transportation Research Institute) Freight Performance Measures (FPM) database compiles anonymous trucking operations data from several hundred thousand trucks using Global Positioning System (GPS) data from onboard trucking systems -- generating billions of data points annually. The truck GPS data generated an average speed and numerous position counts for every hour of the day across 3,311 roadway segments where trucks equipped with the GPS units traveled. The segment speed differences were calculated through extensive analysis between the difference in peak travel times in the morning, mid-day and evening, compared to the off-peak travel times. These times were multiplied by the per-mile truck data sample size for that period. The values for the three periods were added together to generate the total congestion index.

The 100 segments with the highest congestion indices were isolated for further analysis as the top trucking bottlenecks in Missouri. St. Louis and Kansas City contained 81 out of the state's 100 worst truck bottlenecks; however, Springfield also contained several bottlenecks, with several more locations dispersed throughout cities and towns across the State **Figures B-2 and B-3** presents the 100 segments identified as bottlenecks through this analysis.

The rail bottlenecks analysis was completed using the Association of American Railroads' methodology for determining the level of service for a specific freight rail corridor. **Figure B-4** illustrates the volume-to-capacity ratio and the maximum number of trains per day for each freight rail corridor in Missouri.

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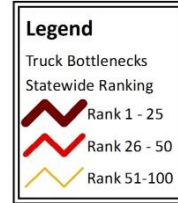
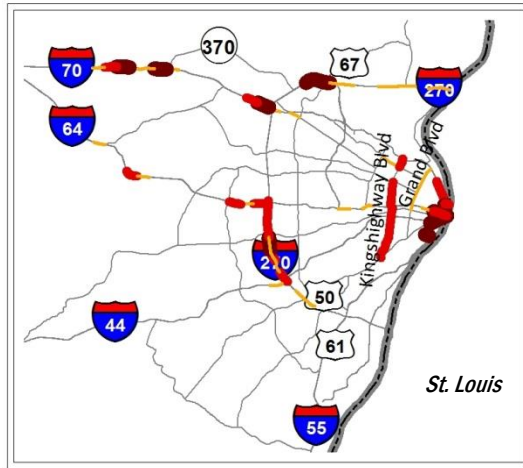
Figure B-2: Top 100 Truck Bottlenecks in Missouri



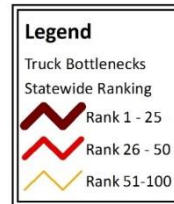
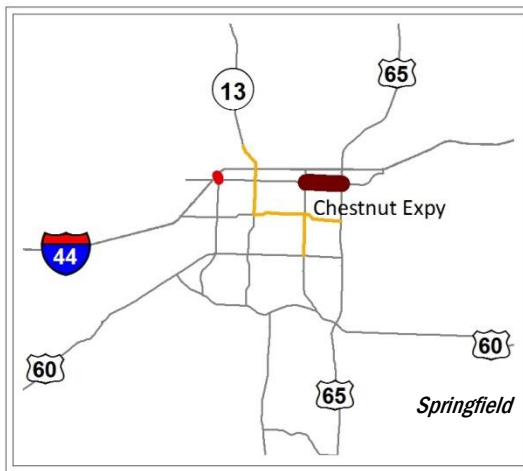
Source: CDM Smith, ATRI, ESRI

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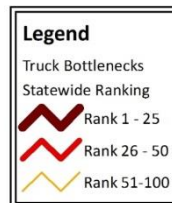
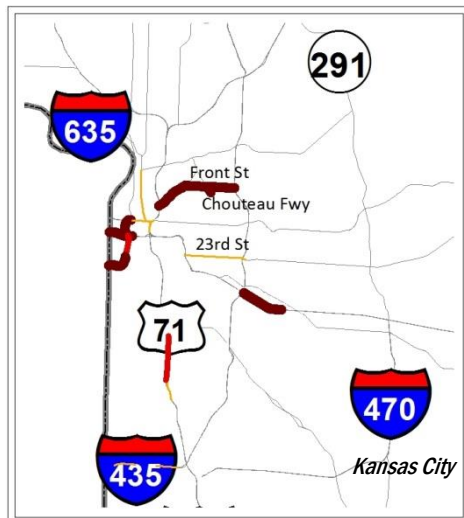
Figure B-3: Regional Truck Bottlenecks



Data Sources: MoDOT and ATRI



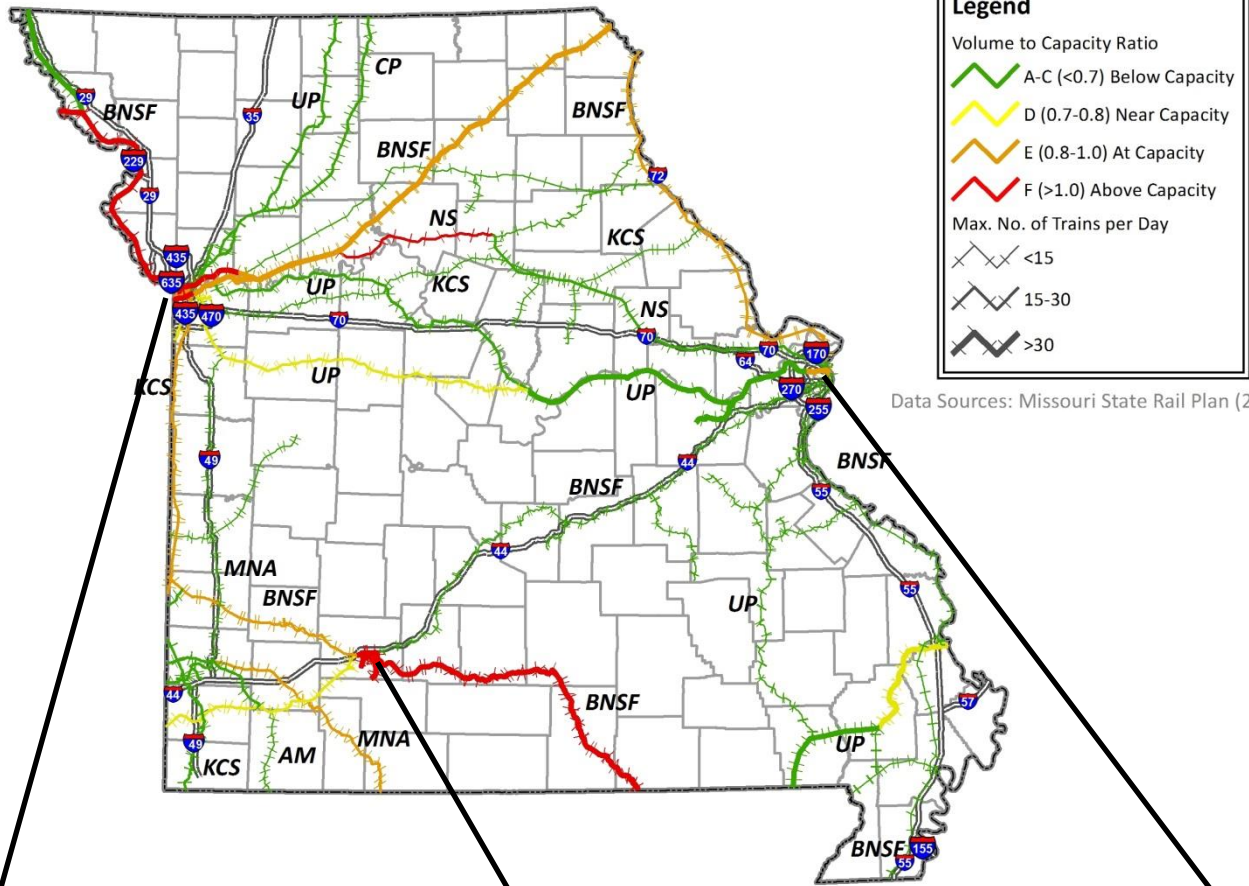
Data Sources: MoDOT and ATRI



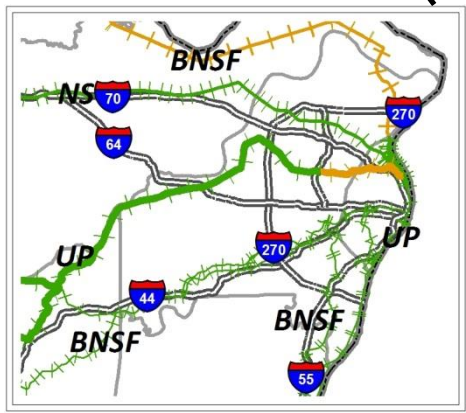
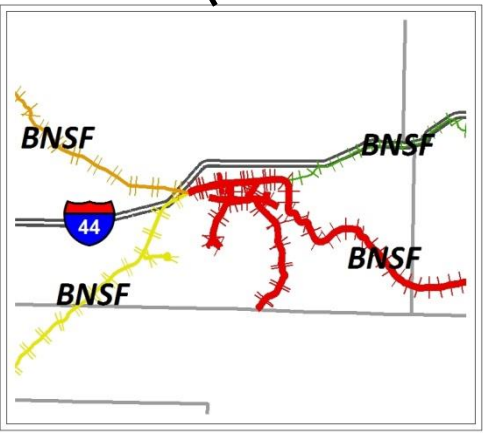
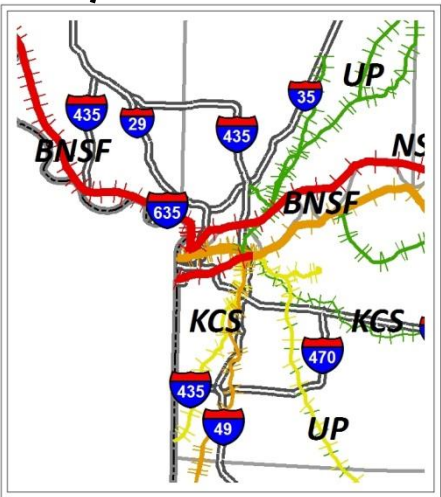
Data Sources: MoDOT and ATRI

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Figure B 4: Rail Corridor Volume Capacity



Data Sources: Missouri State Rail Plan (2012)



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Economics

Freight Commodity Growth

The analysis of the type of freight commodities, a commodity's tonnage, a commodity's dollar value and the directional movement (into, out of, within or through Missouri) being transported help illustrate the importance of freight movements to Missouri from different perspectives. Each of these perspectives assists in estimating the economic impacts of freight movement.

Directional Movement – Directional freight movements impact Missouri differently.

- Inbound commodities from out-of-State comprise two basic types: final goods and intermediate production materials (inputs). Final goods typically go directly to consumers or to retail outlets; hence, associated economic impacts are, at most, a function of retail price markups. Comparatively, economic impacts associated with inbound materials used in Missouri manufacturing processes can be quite significant.
- Outbound commodities from Missouri to other states also represent the result of value-added Missouri production. Additionally, intrastate Missouri movements represent both value-added Missouri production and/or retail price markups.
- Freight movements through Missouri generate little, if any, economic value to the State (i.e., transport service only). Nonetheless, the magnitude of through truck and rail volumes is important in a freight plan given the effect on modal infrastructure capacity.

Commodity Tonnage and Value – While it is important to understand tonnage movements, such observations do not unilaterally address the importance of freight movements to Missouri (other considerations matter such as value, direction, mode, etc.). Top commodity tonnages (via all modes and directions, combined) are led by Coal (237.6 million, 23.4%), followed by Farm Products (129.2 million, 12.7%), and Nonmetallic Minerals (such as limestone, sand, clay and granite) (123.7 million, 12.2%); see **Table B-1**. Comparatively, the top commodity value movements (via all modes and directions, combined) are led by Miscellaneous Mixed Shipments (\$189.3 billion, 15.7%), followed by Transportation Equipment (\$163.7 billion, 13.6%), and Secondary Traffic (is common with distribution centers when products A, B, and C arrive for storage and is considered secondary traffic when the product leaves the distribution center to a retail outlet or home delivery) (\$161.7 billion, 13.4%), see **Table B-2**.

Since 2011, there are two key shifts impacting commodity movement in Missouri. First is the increase movement of crude oil by rail in Missouri and second is sand produced in eastern Missouri as a valuable input to the oil extracting process known as fracking.

The rapid increase in crude oil from the Bakken region strained existing pipeline capacities and oil refiners. As a result, between 2011 and 2012 crude oil transported by rail has increased 423 percent. With limited available oil rail cars, it is extremely important to have a quick delivery and return to the Bakken oil fields. One solution is to transfer the rail oil tankers to barges for their last leg to oil refineries. There are two Missouri locations with such capability in St. Louis and Hayti, Missouri.

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The St. Peter Sandstone formation mined in eastern Missouri has two unique characteristics – it is nearly pure silica and the grains are almost spherical. These features are unique and work exceptionally well in oil fracking which has led this type of sand to be called fracking sand. As a result, the silica sand is in high demand in North Dakota and Texas. There are four quarries in eastern Missouri where the silica sand is mined. Silica sand is typically transported by rail or barge.

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Table B-1: Top Commodities By Tonnage, 2011

STCC2	Commodity	Tons (in thousands)	
		Amount	Percent
11	Coal	237,585	23.4%
01	Farm Products	129,200	12.7%
14	Nonmetallic Minerals	123,662	12.2%
20	Food or Kindred Products*	98,474	9.7%
28	Chemicals or Allied Products	84,647	8.3%
50	Secondary Traffic	83,952	8.3%
29	Petroleum or Coal Products	47,132	4.6%
46	Misc Mixed Shipments	37,592	3.7%
32	Clay, Concrete, Glass or Stone	31,538	3.1%
37	Transportation Equipment	19,410	1.9%
	Remaining Commodities	123,557	12.2%
	Total	1,016,748	100.0%

*kindred products includes manufactured or processed foods for human consumption such as manufactured ice, chewing gum and animal or vegetable cooking oils and fats.

Source: TRANSEARCH® data for 2011

Table B 2: Top Commodities By Value, 2011

STCC2	Commodity	Value (in millions)	
		Amount	Percent
46	Misc Mixed Shipments	\$189,344	15.7%
37	Transportation Equipment	\$163,658	13.6%
50	Secondary Traffic	\$161,694	13.4%
28	Chemicals or Allied Products	\$134,438	11.2%
20	Food or Kindred Products	\$99,907	8.3%
01	Farm Products	\$57,608	4.8%
35	Machinery	\$57,147	4.7%
36	Electrical Equipment	\$54,732	4.5%
33	Primary Metal Products	\$50,411	4.2%
29	Petroleum or Coal Products	\$42,095	3.5%
	Remaining Commodities	\$194,573	16.1%
	Total	\$1,205,607	100.0%

Source: TRANSEARCH® data for 2011

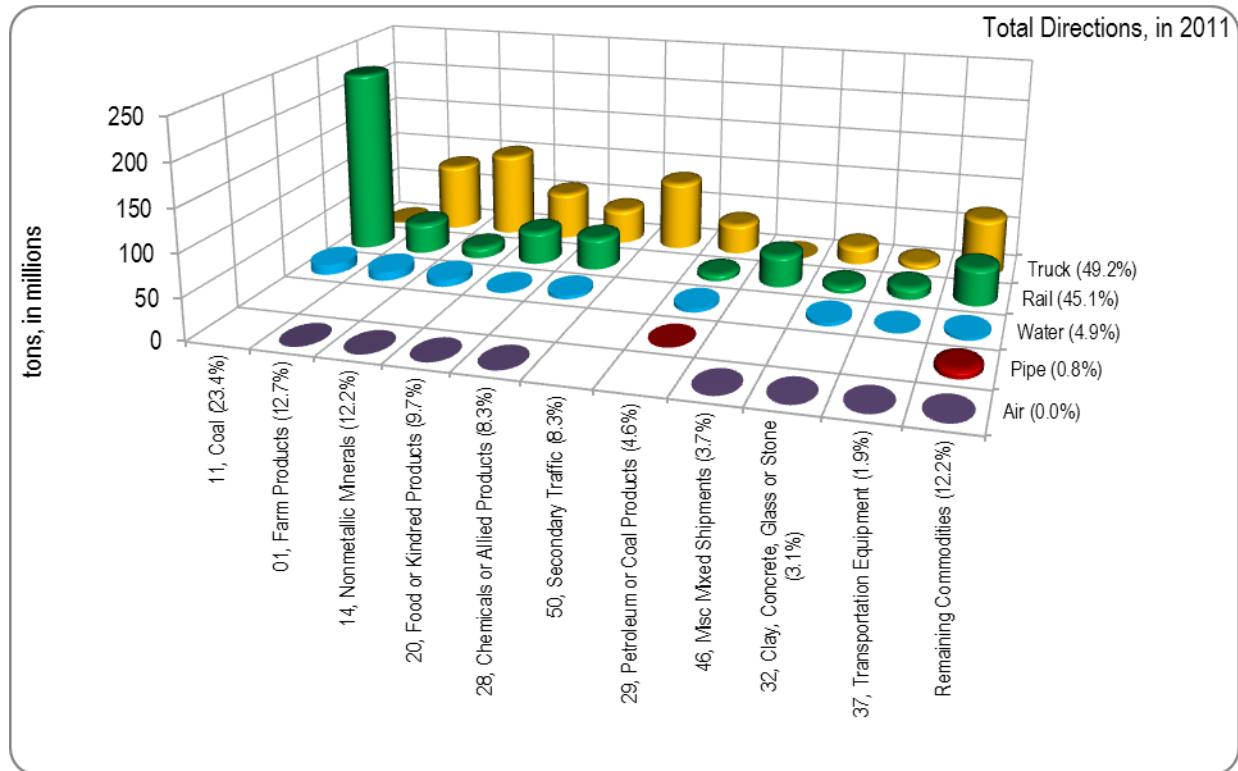
Commodity Tons by Mode – Figure B-5 illustrates modal differences by commodity tonnage. Truck leads most commodity ton movements, especially Farm Products, Nonmetallic Minerals, and Secondary Traffic, as well as other Remaining Commodities; however, rail-based Coal is by far the largest single commodity movement. Port, air, and pipeline commodity ton movements are all dwarfed by truck and rail.

Commodity Value by Mode – Figure B-6 shows modal differences by commodity value, as compared to the ton volumes. A similar pattern is observed, with truck-based commodity movement generally

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exceeding all other modes, especially, Food and Kindred Products, Farm Products, Secondary Traffic, and other Remaining Commodities. However, rail-based Miscellaneous Mixed Shipments are the largest movement by value, and rail-based Transportation Equipment movement value exceeds truck. Similarly to tonnage movements, the port, air, and pipeline value movements are all insignificant compared to either truck or rail.

Figure B-5: Top Commodities by Tonnage and Mode, 2011

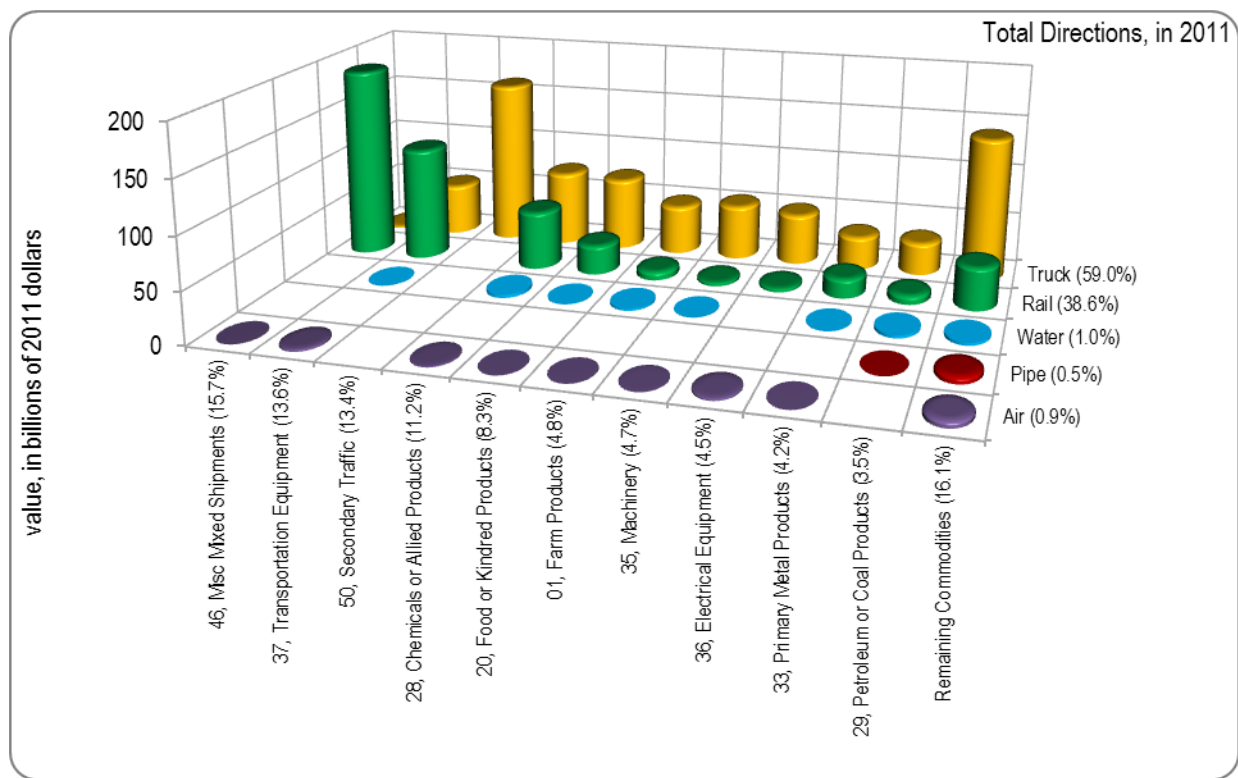


Source: TRANSEARCH® data for 2011

Reliance on the highway and rail systems will continue into the future as the primary freight modes in Missouri. Missouri is and will continue to accommodate a large percentage of through freight movements which places a strain on the Missouri system due to maintenance requirements from the freight passing through the State.

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Figure B-6: Top Commodities by Value and Mode, 2011



Source: TRANSEARCH® data for 2011

Freight tonnage across the Missouri freight network is forecast to grow 37.3 percent from 2011 to 2030 (1.7 percent annually). Truck and rail are by far the dominant modes of freight transportation in Missouri. Truck movements account for 49 percent of the total tonnage and rail movements account for 45 percent. Truck growth is forecast to grow by 55.5 percent (2.4 percent annually), from 500.4 million tons in 2011 to 778.1 million in 2030, a 277.7 million ton increase. In the context of the aggregate 378.8 million ton growth forecast for all combined modes, this 277.7 million increase in truck constitutes 73.3 percent, about half of which is attributable to through movements. While rail growth is forecast to grow by 19 percent (0.9 percent annually), from 458.1 million tons in 2011 to 545.2 million tons in 2030, it still constitutes 40 percent of the total tonnage moved through Missouri. Additional details are available in Appendix A.

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Truck Forecast

Table B-3 depicts the directional composition of truck movements in Missouri between 2011 and 2030, which is relatively constant over the future analysis horizon. Truck tonnage is forecast to increase from 500.4 million in 2011 to 778.1 million in 2030, a cumulative increase of 55.5% (2.4% annually). Truck commodity value is forecast to increase from \$710.9 billion in 2011 to \$1.20 trillion by 2030, a cumulative increase of 68.4% (2.8% annually). Truck freight density growth across the Missouri road network is shown in **Figure B-7**, which indicates the greatest volume increases on I-44 and I-55.

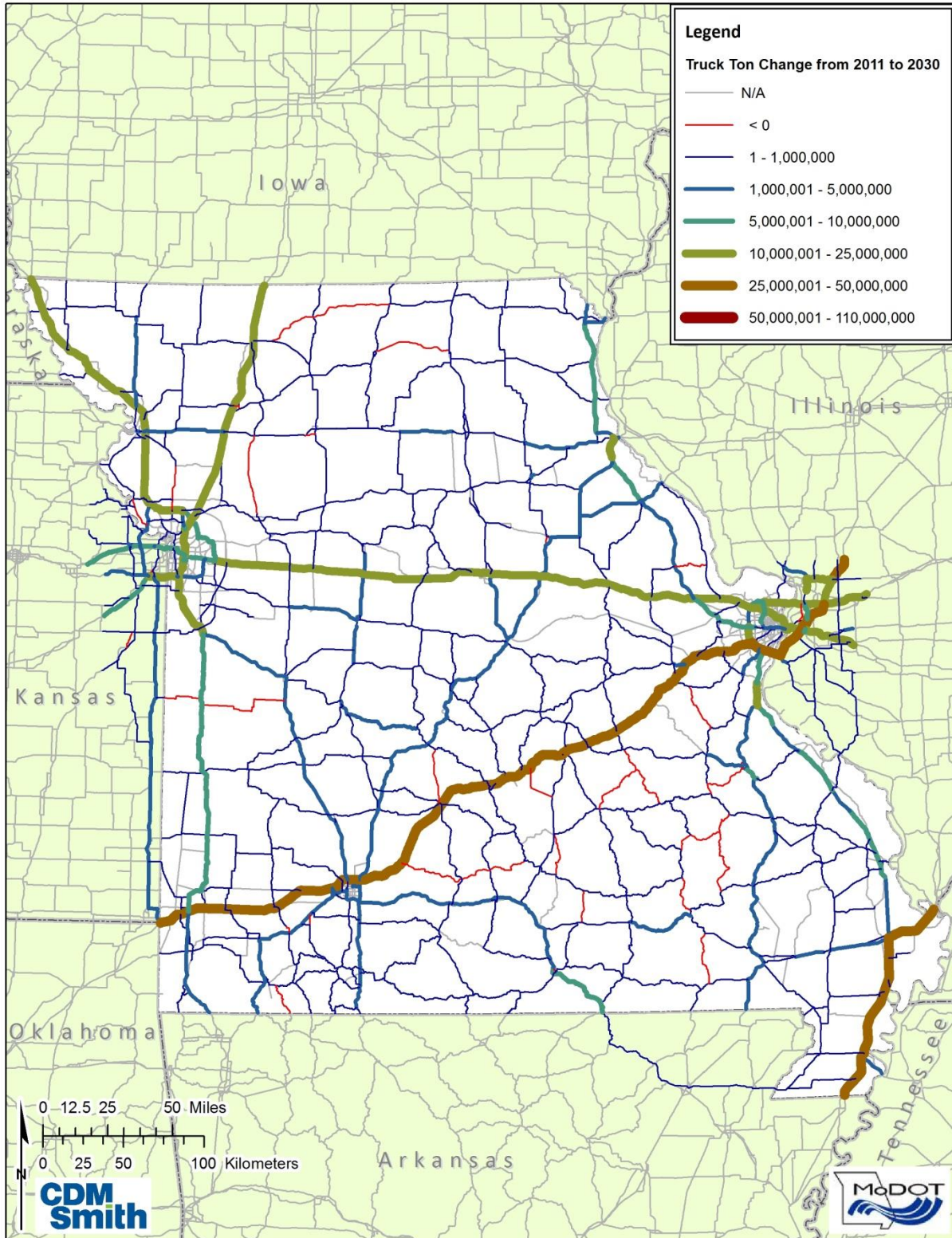
Table B-3: Truck Forecast by Direction, 2011 to 2030

Direction	2011		2030		Percent Change	
	Amount	Percent	Amount	Percent	Total	CAGR
Tons						
Outbound	75,301,621	15.0%	108,430,027	13.9%	44.0%	1.9%
Inbound	89,250,507	17.8%	129,095,659	16.6%	44.6%	2.0%
Intra	105,627,915	21.1%	182,656,763	23.5%	72.9%	2.9%
Through	230,212,488	46.0%	357,953,967	46.0%	55.5%	2.4%
Total	500,392,531	100.0%	778,136,417	100.0%	55.5%	2.4%
Value, in millions						
Outbound	\$95,005	13.4%	\$139,161	11.6%	46.5%	2.0%
Inbound	\$119,731	16.8%	\$194,892	16.3%	62.8%	2.6%
Intra	\$62,346	8.8%	\$78,333	6.5%	25.6%	1.2%
Through	\$433,794	61.0%	\$784,501	65.5%	80.8%	3.2%
Total	\$710,876	100.0%	\$1,196,888	100.0%	68.4%	2.8%

Source: TRANSEARCH® data for 2011

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Figure B-7: Truck Ton Growth, 2011 to 2030



Source: TRANSEARCH® data for 2011

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By 2030, the Missouri highway freight system is projected to support more than 63.2 million truck trips which will total over of 778.1 million tons and be valued at \$1.20 trillion with an average value/ton of \$1,538. The top five truck commodities by tonnage, units, value and growth can be reviewed in Appendix A.

Rail Forecast

Table B-4 depicts the directional composition of rail movements in Missouri between 2011 and 2030, which is relatively constant over the future analysis horizon. Rail tonnage is forecast to increase from 458.1 million in 2011 to 545.2 million in 2030, a cumulative increase of 19.0% (0.9% annually). Rail commodity value is forecast to increase from \$465.0 billion in 2011 to \$790.6 billion by 2030, a cumulative increase of 70.0% (2.8% annually). Note that inbound tonnage is forecast to decline.

Freight density growth across the Missouri rail network is shown in **Figure B-8**, which indicates the greatest rail volume increases on the BNSF line connecting Kansas City and Chicago.

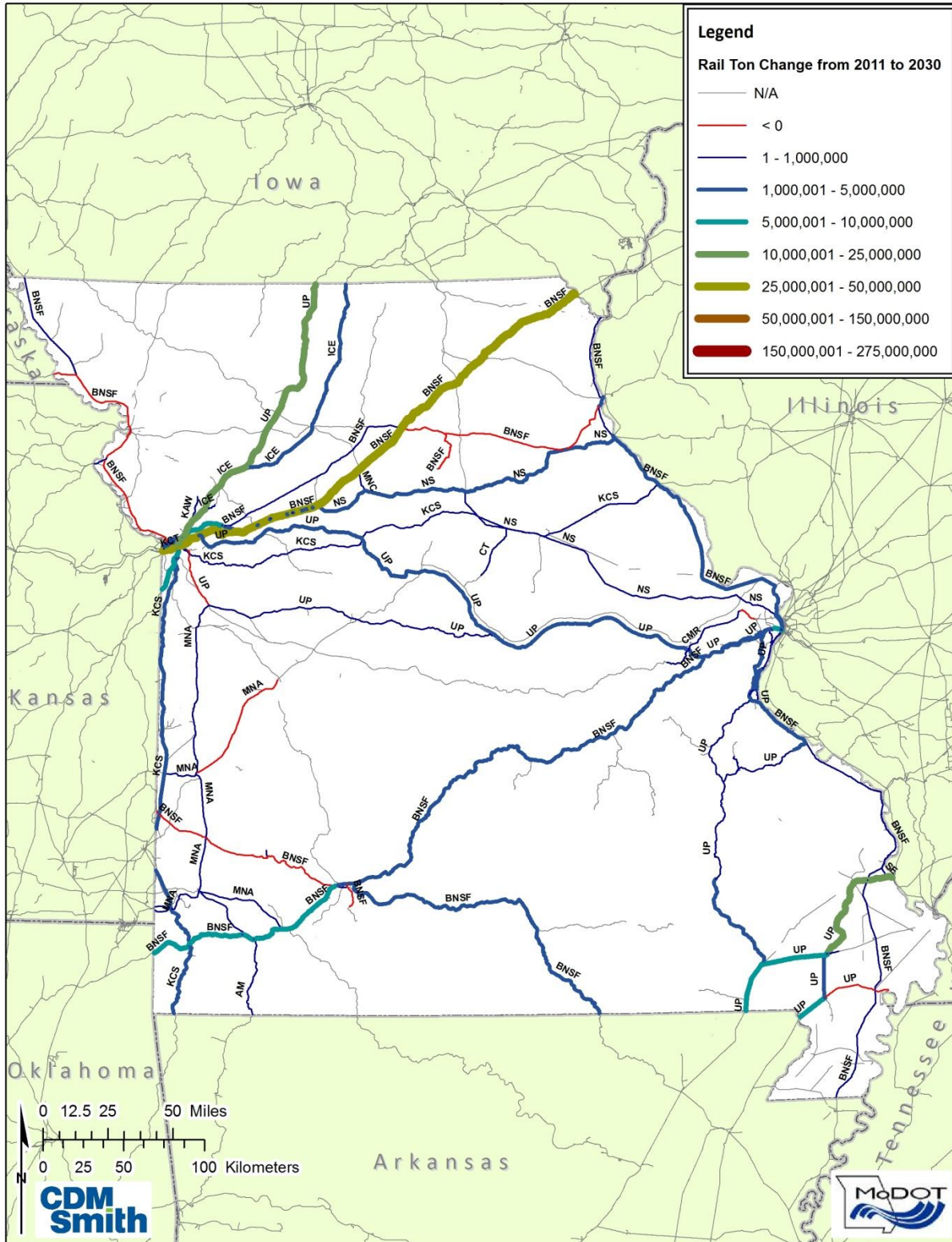
Table 4: Rail Forecast by Direction, 2011 to 2030

Direction	2011		2030		Percent Change	
	Amount	Percent	Amount	Percent	Total	CAGR
Tons						
Outbound	21,510,433	4.7%	35,366,325	6.5%	64.4%	2.7%
Inbound	92,326,793	20.2%	90,178,404	16.5%	-2.3%	-0.1%
Intra	2,436,087	0.5%	3,237,194	0.6%	32.9%	1.5%
Through	341,805,597	74.6%	416,384,127	76.4%	21.8%	1.0%
Total	458,078,910	100.0%	545,166,049	100.0%	19.0%	0.9%
Value, in millions						
Outbound	\$40,364	8.7%	\$67,228	8.5%	66.6%	2.7%
Inbound	\$39,647	8.5%	\$64,535	8.2%	62.8%	2.6%
Intra	\$1,616	0.3%	\$3,393	0.4%	110.0%	4.0%
Through	\$383,409	82.4%	\$655,439	82.9%	71.0%	2.9%
Total	\$465,035	100.0%	\$790,595	100.0%	70.0%	2.8%

Source: TRANSEARCH® data for 2011

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Figure B-8: Rail Ton Growth, 2011 to 2030



Source: TRANSEARCH® data for 2011

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The anticipated rail movement in Missouri is expected to total 545.2 million tons, carried via 12.0 million rail cars, valued at \$790.6 billion in 2011 with an average value/ton of \$1,450. The top five rail commodities by tonnage, units, value and growth can be reviewed in Appendix A.

Port Forecast

Table B-5 depicts the projected directional composition of public port movements in Missouri between 2011 and 2030, which is relatively constant over the future analysis horizon; but, intrastate movements increase somewhat (albeit, continuing to be relatively insignificant compared to other directional port movements). Port tonnage is forecast to increase from 49.9 million in 2011 to 63.3 million in 2030, a cumulative increase of 26.9% (1.3% annually). Port commodity value is forecast to increase from \$12.5 billion in 2011 to \$15.4 billion by 2030, a cumulative increase of 23.1% (1.1% annually).

Table 5: Port Forecast by Direction, 2011 to 2030

Direction	2011		2030		Percent Change	
	Amount	Percent	Amount	Percent	Total	CAGR
Tons						
Outbound	19,973,291	40.1%	25,917,689	41.0%	29.8%	1.4%
Inbound	5,093,847	10.2%	5,906,771	9.3%	16.0%	0.8%
Intra	4,941,503	9.9%	9,565,245	15.1%	93.6%	3.5%
Through	19,850,043	39.8%	21,865,151	34.6%	10.2%	0.5%
Total	49,858,684	100.0%	63,254,857	100.0%	26.9%	1.3%
Value, in millions						
Outbound	\$3,479	27.7%	\$4,302	27.8%	23.6%	1.1%
Inbound	\$3,083	24.6%	\$4,060	26.3%	31.7%	1.5%
Intra	\$117	0.9%	\$253	1.6%	116.2%	4.1%
Through	\$5,870	46.8%	\$6,833	44.2%	16.4%	0.8%
Total	\$12,549	100.0%	\$15,448	100.0%	23.1%	1.1%

Source: TRANSEARCH® data for 2011

The 2030 commodity movements by port are estimated to reach 63.3 million tons, be valued at \$15.4 billion and have an average value/ton of \$244. The top five port commodities by tonnage, units, value, and growth can be reviewed in Appendix A.

Air Forecast

Table B-6 depicts the directional composition of air movements in Missouri between 2011 and 2030, which changes somewhat over the future analysis horizon; outbound movements decrease in relative proportion, while inbound movements increase. Air tonnage is forecast to increase from 73,003 in 2011 to 139,296 in 2030, a cumulative increase of 90.8% (3.5% annually). Air commodity value is forecast to increase from \$11.4 billion in 2011 to \$27.5 billion by 2030, a cumulative increase of 141.8% (4.8% annually).

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Table B-6: Air Forecast by Direction, 2011 to 2030

Direction	2011		2030		Percent Change	
	Amount	Percent	Amount	Percent	Total	CAGR
Tons						
Outbound	34,313	47.0%	54,382	39.0%	58.5%	2.5%
Inbound	38,249	52.4%	84,077	60.4%	119.8%	4.2%
Intra	370	0.5%	726	0.5%	96.2%	3.6%
Through	71	0.1%	112	0.1%	56.8%	2.4%
Total	73,003	100.0%	139,296	100.0%	90.8%	3.5%
Value, in millions						
Outbound	\$7,620	66.9%	\$16,592	60.3%	117.7%	4.2%
Inbound	\$3,656	32.1%	\$10,681	38.8%	192.1%	5.8%
Intra	\$100	0.9%	\$245	0.9%	144.5%	4.8%
Through	\$10	0.1%	\$16	0.1%	65.2%	2.7%
Total	\$11,387	100.0%	\$27,534	100.0%	141.8%	4.8%

Source: TRANSEARCH® data for 2011

The 2030 commodity movements by air are estimated to reach 139,296 tons and be valued at \$27.5 billion, with an average value/ton of \$197,667. The top five rail commodities by tonnage, units, value and growth are shown in Appendix A.

Pipeline Forecast

Table B-7 depicts the directional composition of pipeline movements in Missouri between 2011 and 2030, which remains completely constant over the future analysis horizon. Pipeline tonnage is forecast to increase from 8.3 million tons in 2011 to 8.9 million in 2030, a cumulative increase of 6.5% (0.3% annually). Pipeline commodity value is forecast to increase from \$5.8 billion in 2011 to \$6.1 billion by 2030, a cumulative increase of 6.5% (0.3% annually).

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Table B-7: Pipeline Forecast by Direction, 2011 to 2030

Direction	2011		2030		Percent Change	
	Amount	Percent	Amount	Percent	Total	CAGR
Tons						
Outbound	N/A	N/A	N/A	N/A	N/A	N/A
Inbound	932,258	11.2%	993,713	11.2%	6.6%	0.3%
Intra	N/A	N/A	N/A	N/A	N/A	N/A
Through	7,412,827	88.8%	7,896,550	88.8%	6.5%	0.3%
Total	8,345,085	100.0%	8,890,264	100.0%	6.5%	0.3%
Value, in millions						
Outbound	N/A	N/A	N/A	N/A	N/A	N/A
Inbound	\$643	11.2%	\$686	11.2%	6.6%	0.3%
Intra	N/A	N/A	N/A	N/A	N/A	N/A
Through	\$5,117	88.8%	\$5,451	88.8%	6.5%	0.3%
Total	\$5,761	100.0%	\$6,137	100.0%	6.5%	0.3%

Source: TRANSEARCH® data for 2011

In Missouri, growth in pipeline movements is effectively attributable to increases in only one commodity: Crude Petroleum and Natural Gas. A majority of that tonnage and value increase will be from pipeline movements traveling through Missouri.

Trade and Industry Growth

There is a close relationship between industrial health and vitality and available transportation options. Industries need parts and supplies to manufacture products that are then transported across the state, country, and world. In Missouri, the goods range from agricultural grains and food products to automobiles. Transportation is responsible for bringing supplies into Missouri as well as exporting the products of Missouri industries.

Nationally, continued growth in employment and investment in advanced industries is occurring. These industries include pharmaceuticals and medicine; industrial machinery; commercial and service industry machinery; engines, turbines, and power transmission equipment; communications equipment; measurement and calibration equipment; electro-medical and control instruments; aerospace products and parts; motor vehicles; and medical equipment and supplies. Advanced industries account for 11 percent of Gross Domestic Product and 80 percent of all private-sector research and development investments, as well as one-third of all U.S. exports. These industries employ over 7.4 million in the U.S. and almost half of those jobs are available to workers with less than a four-year college degree. Advanced industries rely on thousands of domestic supplier firms supporting an estimated 5.1 million additional jobs in their direct supply chains. These industries are projected to add an estimated 2 million new jobs over the next 10 years; wages in this sector are almost twice as much on average as non-advanced industry companies. Regions and states are actively recruiting firms in these sectors and providing incentives to retain these businesses. Many advanced

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industries are transportation-dependent. Advanced Manufacturing Industries in Missouri employed 175,396 workers in 2012 and average annual salaries were \$77,060.

Manufacturing productivity in the U.S. increased 73 percent between 1993 and 2011 according to the U.S. Department of Commerce, contributing \$1.87 trillion to the U.S. economy in 2012. More than 60 percent of U.S. exports are manufactured goods, and as new markets continue to open and global incomes continue to improve, businesses stand to achieve even greater export-related revenues and profits. Although direct manufacturing jobs have declined over the past two decades, indirect jobs in engineering, design, marketing, and finance that support manufacturing operations generate 68 cents for every dollar of manufacturing wages. Today U.S. manufacturing accounts for 20 percent of the world's manufacturing output and U.S. manufacturing value-added (for example, the increase in the value of individual auto parts versus the value of a finished vehicle) is greater than that of China, India, Brazil, and Russia combined.

Exports of aircraft have doubled since 2009, driven by demands from Asia and the Middle East, and industry experts project a significant increase in the size of global aircraft fleets by 2031 which can translate to significant business opportunities for the Missouri aerospace and aviation sector. In Missouri 14,235 are employed in aerospace products and aerospace parts manufacturing with average annual salaries of \$102,882.

The most export-dependent industries in Missouri (those industries that export 50 to 75 percent of production internationally) include: agricultural products, food, mining machinery and equipment, communication and energy wire manufacturing, chemical manufacturing, measurement and calibration equipment manufacturing.

Export industries in Missouri account for 95,000 direct jobs. The St. Louis metro area exported \$19 billion in goods and services in 2012, reflecting a 7.9 percent growth in exports from 2009 – 2012. The top three export gainers were aircraft, motor vehicles, non-ferrous metal products. The Kansas City metro area exported \$11.5 billion in goods during 2012, resulting in an 8.7 percent growth in exports from 2009 – 2012. The top three export gainers were motor vehicles, aircraft, and communications equipment.

Chemicals are Missouri's second largest international export and employ over 17,000 workers, with clusters in St. Louis and northeast and northwest Missouri. U.S. chemical companies have earmarked \$25 billion in new investments for expansion of existing facilities or construction of new facilities according to a recent study by the American Chemistry Council. Missouri may be able to benefit from these new investments. The availability of lower cost energy and feedstock from shale gas has significantly improved the outlook for chemical manufacturing, although some risks on the horizon still exist in regulatory environments, as well as supply line concerns in new growth economies.

Missouri food and food ingredient exports have increased by 148% since 2005. Top agriculture export products include soybeans, corn, cotton, pork, vegetable oils, oilcake, meal, and wheat. Major food processing companies in Missouri include: Farmland, Fricks, IDF, Russell Stover, Anheuser-Busch, Bissinger's, and McCormick Distilling. Increasing global wages have resulted in increased demand for U.S. agricultural products due to higher quality standards and variety.

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The Panama Canal, originally constructed in 1914, is now undergoing a \$5.25 billion expansion to be completed in 2015. The completion of the canal opened one of the most important trade links in the world by linking the Atlantic and Pacific Oceans. When the canal expansion is complete the new locks will allow for deeper, longer and wider vessels, doubling its existing throughput capacity⁴. Reduction of transportation costs due to Canal expansion could affect the movement of goods on inland waterways in two ways. A reduction in ocean transportation costs out of Gulf ports due to the use of larger, more efficient ships will tend to reduce aggregate costs of exporting bulk commodities, such as grain, by the Mississippi River route rather than by rail through Pacific Northwest ports. Second, lower transportation costs attributable to expansion of the Canal could increase export volumes as the transportation element of U.S.-produced commodity costs helps to make U.S. exports more competitive in world markets. While the scale and timing of the impacts to Missouri freight flows is unknown at this time, it is anticipated that the expansion will change international trade flows and change the demands on transportation networks, service and operation.

All of these growth factors will lead to a growth in freight movements within Missouri. The growth in freight movements will result in increasing demands on the highways, rail lines, port facilities and airports handling air cargo freight.

Institutional and Regulatory Trends

Federal regulatory trends may affect Missouri freight transportation. An example would be the implications from incremental Federal regulation of trucking and trucker safety (e.g. hours of service (HOS)), electronic logging devices (ELD), compliance-safety-accountability (CSA), EPA truck engine /reefer trailer regulations) or even speculation about how truck size and weight affects trucking services pricing, trucking network operations and mode choice. These trends may increase the cost of freight movements by truck, resulting in some commodities possibly switching to a different mode. A driver shortage may increase the transport time and affect frequency of deliveries, or require distribution centers, warehouses, and stores to maintain a larger backlog of products.

Other freight-related trends might be recent public-private partnerships (P3), which involve use of private capital for transportation infrastructure projects. In these cases, availability payment mechanisms are becoming more preferred on the part of investors compared with earlier pure operating concession / equity investments. This trend could impact freight by increased operating cost in the form of tolls; however, freight would also benefit through a greater reliability of the highway facility.

Other possible trends in the Federal public policy area which could affect transportation include:

- Federal water resource policy-making criteria can significantly impact the reliability of waterborne freight usage from year to year by reducing the navigable days during extreme conditions.

⁴ Panama Canal Expansion Study – Phase I Report, US Department of Transportation, November 2013.

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- The aging and outdated lock and dam system is in need of replacement to efficiently accommodate barges; however, there is currently no Congressional funding to accomplish this. A lock and dam failure could dramatically shift barge commodities to rail or truck.
- U.S. Department of Agriculture (USDA) and foreign government food product traceability requirements make bulk (barge, unit train) food shipping less attractive to some shippers.
- U.S. Department of Homeland Security (DHS) requirements for electronic pre-filing of export documentation for exported commodity shipments are viewed by some shippers as an impediment to export flows, as it potentially adds time. This may lead to an increase in foreign trade zones for export shipments as a way to consolidate security procedures.
- U.S. Environmental Protection Agency (EPA) additional tier emissions requirements for marine diesel barge engines and rail locomotive engines will increase costs to companies which would be required to retrofit or replace existing engines.
- Connected Vehicles is an emerging technology that allows vehicles to travel closer together, at a consistent speed through the use of technology. The use of dedicated short range communications allows vehicles to share speed and braking information, allowing surrounding vehicles to automatically adjust. It can provide a more reliable travel time on the highways by reducing crashes and travel speed variations.
- At the local and statewide level, the acceptance of “Complete Streets” is a growing trend that may impact the movement of freight, particularly in the last mile of delivery. To date 18 cities/counties and five regional planning organizations have “Complete Street” policies. The Missouri General Assembly passed a resolution in support of Complete Street policies at all levels of government in May 2011. With a growing trend of increasing home delivery of products ordered on-line and in-store, Complete Street policies need to plan for ways to accommodate home delivery vehicles.

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MAP-21 Comprehensive Truck Size and Weight Study

During the last transportation reauthorization (MAP-21), Congress called on the USDOT to conduct a study on specific areas of federal truck size and weight limits, including their operation and their impacts. Congress requested an evaluation of several alternative truck configurations (Table B-8). The analysis of these configurations will address differences in safety risks, infrastructure impacts, and the effect on levels of enforcement between trucks operating at or within Federal limits and trucks legally operating in excess of Federal limits. The study will also estimate the effects of freight diversion from other modes due to these alternative configurations. The results of this study are due to Congress prior to the next transportation reauthorization. Currently the study is scheduled to be completed in the fall of 2014. These shifts could affect the volume of truck traffic that would be required to carry a given amount of freight and the weights of trucks traveling on different parts of the highway system. These changes in turn will affect safety, infrastructure preservation costs, productivity, energy consumption, environmental emissions and other factors.

Table B-8: Configurations for Analysis in the Comprehensive Truck Size and Weight Limits Study⁵

Configuration	Configuration Description	Trailers or Semi-Trailers (#)	Axles (#)	Gross Vehicle Weight (lbs.)
1.	Five-axle vehicle	1	5	80,000 [baseline]
		1	5	88,000
2.	Six-axle vehicle	1	6	91,000
		1	6	97,000
3.	Tractor plus two 28 or 28 ½ foot trailers	2	6	80,000 [baseline]
4.	Tractor plus twin 33 foot trailers	2	6	80,000
5.	Tractor plus three 28 or 28 ½ foot trailers	3	7	105,500
6.	Tractor plus three 28 or 28 ½ foot trailers	3	9 or 10	129,000

Source: FHWA Freight Management and Operations web: <http://www.ops.fhwa.dot.gov/freight/sw/map21tswstudy/index.htm>

Regulatory Impacts on Trucking Labor Productivity and Availability

The Federal Motor Carrier Safety Administration (FMCSA) regulates hours of service (HOS) for commercial truck drivers with the goal of preventing job conditions from causing excess fatigue in order to increase safety. In general, drivers of property-carrying commercial vehicles are limited to driving a maximum of 11 hours after 10 consecutive hours off duty. Drivers are also limited to 60 hours of driving in seven days or 70 hours in 8 days. FMCSA updated HOS regulations in December 2011 to limit '34-hour restarts' to once per week. This provision allows for a driver to 'reset' the amount of hours they have driven for a given week by being off-duty for 34 consecutive hours. The new rule also requires

⁵ FHWA Freight Management and Operations web: <http://www.ops.fhwa.dot.gov/freight/sw/map21tswstudy/index.htm>

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drivers to take a 30 minute rest every 8 hours.⁶ The new provisions took effect July 1, 2013, after many legal challenges that prevented the FMCSA from reducing the HOS from 11 to 10 hours per shift. If regulations limit the operating hours of drivers further, the trucking industry's delivery capacity will also be restricted. The trucking industry is already experiencing a driver shortage, creating a strain on the industry capacity to move freight. Further operating restrictions will only add to this strain.

Federal regulations also require all interstate truck drivers to be 21 years of age or older. However, states are able to set their own age requirement for drivers operating intrastate; in Texas, that age is 18. The trucking industry has raised concerns that the federal age requirement for interstate trucking restricts the labor market for drivers. Combining this restriction with the discretion insurance companies place on young potential truck drivers, carriers often prefer to hire individuals over the age of 23. This is perceived as a negative by the industry because as individuals get older, start families and have increased responsibilities, the long hours and variable locations associated with the truck driving profession may become less desirable to the drivers.

Population

The economy is driven by people. It takes people to produce and manufacture the goods and products that are shipped out of Missouri and it is people that drive the demand for consumable goods within Missouri. As such, an examination of Missouri's projected population trends and growth is a key element in the future of freight.

Population Trends

As Missouri's population and employment grows, the demand for and production of finished goods that will be transported will also increase throughout the state. According to Woods and Poole Economic data, Missouri is expected to have an annual growth rate of 0.62 percent from 2012 to 2040. This results in over a million additional Missourians by 2040. **Table B-9** shows the 10 fastest growing counties by annual growth rate. These growth counties are all located near urban areas of St. Louis, Kansas City, Columbia, Springfield/Branson and Joplin.

Table B-9: Highest Projected Annual Growth Rate by County

County	2012 Population	2040 Population	Annual Growth Rate
Christian	79,824	143,530	2.12
Platte	92,054	163,260	2.07
Cass	100,376	171,910	1.97
Clay	227,577	358,420	1.64
Boone	168,535	263,150	1.60
Lincoln	53,354	79,870	1.45
Newton	59,069	86,110	1.36
Taney	52,956	76,300	1.31
Greene	280,626	397,020	1.25

⁶ "Hours of Service of Drivers, Final Rule." *Federal Register* 76 (27 December 2011): 81134-81188. Web: <http://www.fmcsa.dot.gov/rules-regulations/administration/rulemakings/final/HOS-Final-Rule-12-27-11.pdf>

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St. Charles	368,666	517,450	1.22
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Source: Woods and Poole Economics

Missouri follows national trends of population growth in and around urban counties with less or negative growth in rural counties. By 2040, Missouri population is estimated to be over 7 million people. **Table B-10** identifies the ten most populous counties in 2040. Similar to the projected fastest growing counties, the estimated top 2040 county populations are near St. Louis, Kansas City, Columbia and Springfield.

Table B-10: Highest Projected Population by County

County	2012 Population	2040 Population	Annual Growth Rate
St. Louis	1,000,438	1,050,850	0.18%
Jackson	677,377	682,610	0.03%
St. Charles	368,666	517,450	1.22%
Greene	280,626	397,020	1.25%
Clay	227,577	358,420	1.64%
Jefferson	220,209	295,380	1.05%
Boone	168,535	263,150	1.60%
St. Louis City	318,172	246,080	-0.91%
Cass	100,376	171,910	1.97%
Platte	92,054	163,260	2.07%

Source: Woods and Poole Economics

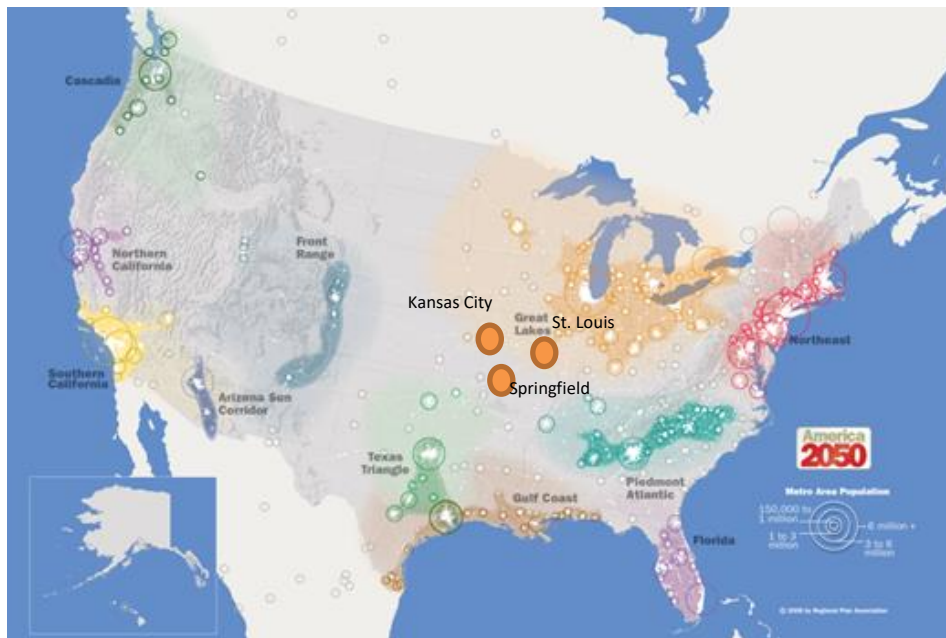
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Mega-Regions

Attention has been given to the concept of mega-regions as geographers, planners, and economists have realized that mega-regions, rather than particular cities, states, or nations, are the real driving force in the world economy.

Ten mega regions in the United States have been identified by America 2050 in their “America 2050: A Prospectus”.⁷ These mega-regions (**Figure B-9**) are where, by mid-century, “more than 70 percent of the nation’s population growth and economic growth is expected to take place,” with an increased movement of goods, people and capital between those regions. As these mega-regions increase their roles in the national and global economy, pressure and increased congestion for ports, highway facilities, railroads, intermodal yards, and other freight facilities will only increase. While specific area delineation differs, by one count, mega-regions in the United States account for only 30 percent of the geographical area, but 77 percent of both population and employment, 81 percent of gross regional product, and 92 percent of Fortune 500 Companies’ revenue (all 2008).⁸ Effective freight planning will take into account not only movement within each of these mega regions, but also freight movement from one mega-region to other mega-regions.

Figure B-9: Emerging Mega Regions



Source: America 2050

The northern portion of Missouri falls within the Great Lakes mega region. Kansas City, St. Louis and Springfield are the closest cities to the western and southern mega regions, providing excellent opportunities as a trade center between these other mega regions.

⁷ America 2050 Prospectus, page. 4.

⁸ Ross, C., & Woo, M., “Megaregions and Mobility.” The Bridge. National Academy of Engineering. Vol 41, No 1 Spring 2011: 27-34

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Infrastructure Preservation

This section highlights the infrastructure maintenance needs on the aging freight network. The maintenance of the nation’s waterway lock and dam infrastructure and highway/bridges are important factors in providing an efficient freight system.

Port and Waterway Maintenance

The lock and dam network, under the jurisdiction of the U.S. Army Corps of Engineers, was implemented to control the river levels and to maintain a minimum nine-foot-deep channel on the upper Mississippi River for more reliable navigation. With the exception of Lock and Dam 26 (Melvin Price), which was opened in the 1990s, the majority of the locks and dams were constructed in the 1930s and are showing their age. The locks and dams are in need of major rehabilitation or replacement which is an expensive undertaking. Replacement may be the most economical option as many of the locks are undersized for today’s larger barge tows.

The seven locks and dams in or near Missouri are part of the Upper Mississippi River starting just north of St. Louis to the Iowa Border and listed in **Table B-11**. The Lower Mississippi River (south of St. Louis) and the Missouri River contain no locks or dams.

Table B-11: Upper Mississippi Locks and Dams in or Near Missouri

Lock/Dam Number	Location
No. 20	Canton, MO
No. 21	Quincy, IL
No. 22	Saverton, MO
No. 24	Clarksville, MO
No. 25	Winfield, MO
No. 26 (Melvin Price)	East Alton, IL
No. 27 (Chain of Rocks Dam)	Glasgow Village, MO
No. 27 (Chain of Rocks Lock)	Granite City, IL

Source: U.S. Army Corps of Engineers

The maintenance needs of the aging infrastructure are increasing at a rate much greater than the operations and maintenance funding provided for the system which adversely affects reliability of the system. Long-established programs for preventive maintenance of major lock components have essentially given way to a fix-as-fail strategy, with repairs sometimes requiring weeks or months to complete. Depending on the malfunction, extended repairs can have major consequences for shippers, manufacturers, consumers, and commodities investors. Replacement may be the most economical and feasible option as many of the locks are undersized at 600 feet and cannot accommodate the standard 15-barge tow configuration which is 1,200 feet. This causes operators to have to run smaller configurations or break down the barges, adding time to a shipping method that is already slower than others.

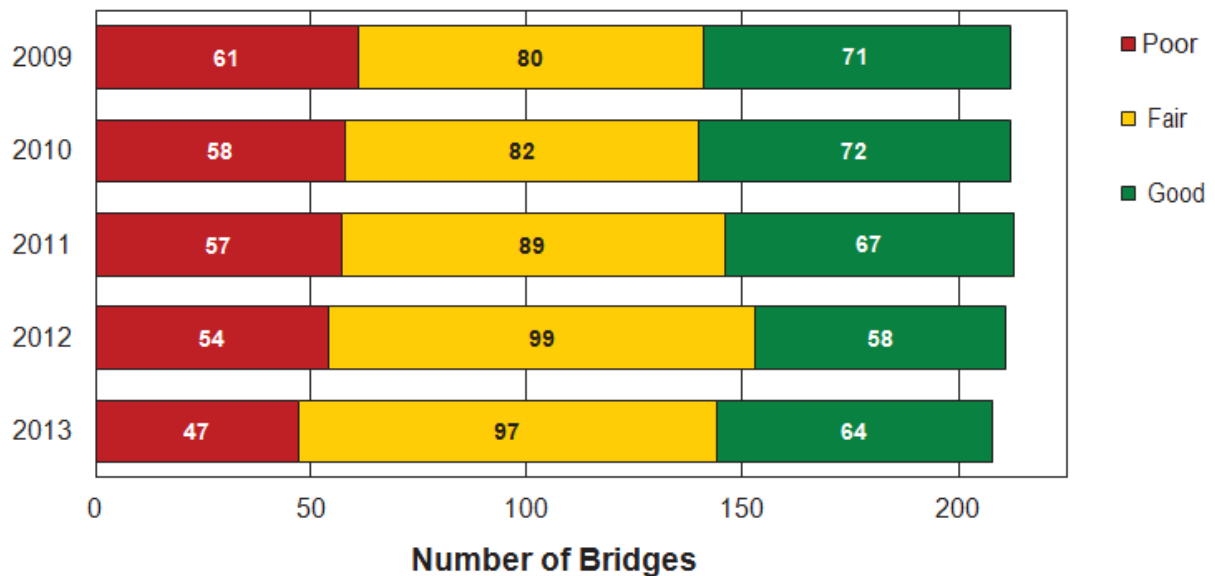
Highway and Bridge Maintenance

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Missouri has more than 33,000 miles of highways and 10,000 bridges to maintain. Currently more than 89 percent of Missouri's major highways are in good condition which is ahead of the 85 percent target set by Missouri. Despite significant investment in Missouri major bridges, which have resulted in decreasing number of structures in the poor category, the number of structures in the good category also decreased. Missouri has 208 major bridges. A major bridge is defined as one that crosses a river or lake and is 1,000 or more feet long. Major bridges are very expensive to rehabilitate and replace. A simple rehabilitation typically costs over \$10 million while major bridge replacements can reach into the hundreds of millions of dollars. Major bridge conditions by year are shown in **Figure B-10** below.

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Figure B-10: Statewide Condition of Major Bridges (208 Total Bridges)



Source: MoDOT Tracker, July 2014 edition

Logistical Challenges

There are a number of logistical challenges facing shippers in Missouri and throughout the Midwest. There are two key direct cost challenges facing shippers. They include the variability of rates as they relate to the variability of fuel costs and truck driver availability. Similar to truck drivers, the availability of truck and rail equipment is an issue shippers are facing. As a result of limited containers and chassis, coordinating equipment movement to assure the necessary volume of chassis and containers are at the same location when they are needed is crucial.

Recently some shippers have had to change container service providers as a result of recent mergers and consolidation alliances. This results in adjustments to processes, reporting and logistical coordination. In addition, shippers must adjust to changes related to content identity and preservation. This is especially true with bulk commodities that will lose their unique characteristics if comingled during storage, handling or shipping. For example, maintaining and preserving organic-raised commodities from traditionally raised commodities is a new challenge.

The challenges facing shippers mentioned above are all in addition to the ongoing challenges of handling growing volumes and the pressures of on-time delivery.⁹

Technology

⁹ Global, National Impacts on Heartland Logistics, Paul Bingham presentation at Heartland Shippers Conference, May 13, 2014

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Today technology is often associated with advanced electronics, but traditionally technology is more broadly defined as the application of *knowledge to the creation and use of technical means and their inter-relation with life, society and the environment.*¹⁰

As freight volumes have dramatically increased across the U.S. during the past several decades, concepts for dedicated freight infrastructure, such as dedicated truck lanes, have increasingly entered the transportation discussion. Dedicated truck lanes physically separate commercial vehicles from passenger vehicles or mixed traffic flows. In recent years a number of states, including California, Florida, Georgia and Texas, have examined dedicated truck lane concepts, as have a number of multistate corridor coalitions such as I-70 and I-10. **Figure B-11** shows an example of a dedicated truck lane. While highway lanes dedicated to commercial vehicles may not seem like advanced technology, separating vehicle streams introduces a new level of complexity in highway design (i.e. on/off ramps) and operations (dealing with incidents or breakdowns).

Missouri has investigated and studied dedicated truck lane opportunities on I-70 in two different efforts. The studies included the I-70 Corridor Environmental Impact Statement (EIS) across the State between the eastside of Kansas City area to the west side of the St. Louis area. Missouri also participated in the I-70 Corridors of the Future planning as one of the four states investigating truck only lanes through Ohio, Indiana, Illinois, and Missouri.

Figure B-11: Example of Dedicated Truck Lanes



To date, few examples exist of operating dedicated truck facilities, and those that do exist tend to be relatively short routes serving ports or key border crossings. The concept of long-distance truck lanes is frequently tied to tolling as the means of raising revenue to support construction. The trucking industry has expressed strong opposition to tolling truck lanes due to high administrative costs compared to traditional fuel taxes and the reluctance or refusal of shippers to reimburse carriers. Some dedicated truck lane concepts would also force trucks off infrastructure constructed in part with taxes and fees already paid by the industry. Benefits associated with dedicated truck-lanes include significant safety gains, the potential of adopting high productivity vehicle (HPV) configurations and the possibility of infusing advanced technologies that fall under the umbrella of Intelligent Vehicle Initiatives (IVI). HPV

¹⁰ Dictionary.com <http://dictionary.reference.com/browse/Technology>

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configurations such as heavier trucks with more axles or longer combination vehicles (LCVs) have been proposed as one means of offsetting the costs of tolls often associated with dedicated truck facilities.

Freight Shuttle System

The Texas A&M Transportation Institute (TTI) has been advancing the concept of an elevated structure dedicated solely to the transport of freight called the Freight Shuttle System (FSS) shown in **Figure B-12**. In this concept, autonomous transporters would carry truck trailers or containers along an elevated guideway designed to be located along the median of an existing right-of-way, usually a freeway or highway. The transporters would use electrically powered linear induction motors that are efficient and do not add emissions on site; guideway construction uses a technique requiring no road closures.¹¹

¹¹ "The Freight Shuttle System: A 21st Century Solution to Freight Transportation Challenges." Texas A&M Transportation Institute. Web. 5 Sep. 2013. <<http://tti.tamu.edu/freight-shuttle/>>.

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Figure 12: Freight Shuttle System Autonomous Transporter and Guideway



Source: TTI

The pilot location proposed for implementation of the FSS is Juarez, Mexico to El Paso, Texas, a distance of 11.7 miles. Freight Shuttle International (FSI) has signed a letter of intent with the City of El Paso, the City of Ciudad Juarez, and the Regional El Paso Economic Development Corporation to privately finance and build the project.^{12,13} If and when it is completed, the FSS could change the dynamic of short- and medium-range freight shipments by reducing congestion and deterioration of roads, increasing import and export capacity, and easing the infrastructure burden on public tax dollars.

As vehicle research and technology continues to explore autonomous vehicles, driverless vehicles are still likely many years away. However, the use of vehicle-to-vehicle and vehicle-to-infrastructure communication to 'train' or platoon groups of vehicles is likely to be seen sooner. Sensor communication between vehicles will adjust the vehicle speed to prevent collisions. Freight and passenger vehicles will benefit from a reduction in congestion related to crashes, reduced operating costs, and more reliable travel times.

Likewise, the Rail Safety Improvement Act of 2008 mandates that Positive Train Control (PTC) be implemented across a significant portion of the nation's rail industry by December 31, 2015. PTC is advanced technology designed to automatically stop or slow a train before accidents occur.

¹² The El Paso Regional Economic Development Corporation (REDCO) merged with the Paso del Norte Group to form the Borderplex Alliance in early 2013.

¹³ Crowder, David. "Freight shuttle for border bridges." El Paso Inc. 23 12 2012, Web. 5 Sep. 2013. <http://www.elpasoinc.com/news/top_story/article_gf741ea4-4d1b-11e2-bd13-0019bb3of31a.html?mode=story>.

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E-Commerce Delivery

E-Commerce in the U.S. increased from 0.6 percent of total retail activity in 1999, to 5.5 percent in the first quarter of 2013. The rapid increase of E-Commerce and related increase to direct home delivery has impacted the freight network. Similar to traditional retailers such as Wal-Mart and Target that have implemented a series of distribution warehouses as part of their supply chain management and to facilitate just-in-time delivery, e-retailers such as Amazon and eBay have constructed a series of centralized distribution centers. E-commerce requires fast, on-time delivery, which is sensitive to both distance and congestion. These distribution centers help the e-commerce retailers achieve next-day or even same day delivery for their products.

Common to this trend is the higher penetration of parcel delivery vehicles into residential neighborhoods delivering products ordered online. According to the 2007 Commodity Flow Survey, the value of freight shipped by parcel, U.S. Postal Service, or courier, increased from 11.8 percent of total freight by value in 2002 to 13.4 percent in 2007. As residential deliveries increase, planners fear an increase in related congestion and wear and tear to the local road network as this form of freight traffic disperses from major arterial networks into local neighborhoods. The short temporary parking requirements of delivery vehicles will need to be considered as state and local governments implement “Complete Streets”.

Energy

Natural gas, as compressed natural gas (CNG) and liquefied natural gas (LNG), is the fastest-growing fuel in the transportation sector, with an average annual growth rate of 11.9 percent from 2011 to 2040.¹⁴ Heavy duty vehicles (HDVs)—which include tractor trailers, vocational vehicles, buses, and heavy-duty pickups and vans with a gross vehicle weight rating (GVWR) of 10,001 pounds or more—lead the growth in natural gas demand throughout the projection period.¹⁵ However there is an initial high total cost to retrofit or replace existing equipment. If trucking companies elect to make the switch, they will first need public LNG fuel stations every 400 miles on major truck corridors before adopting alternative fuels for their fleets.

Natural gas prices remain comparatively lower than other countries in 2014, which provides enormous competitive advantage to the nation’s energy-intensive industries. As companies invest to capitalize on lower energy costs, heavy manufacturing is likely to grow and outbound rail and waterway freight transportation is a key to siting plants.

If global conditions do not change, the price of diesel fuel is likely to remain stable or increase. The diesel fuel used in extracting oil and natural gas from shale rock formations sets a price floor for diesel. The outlook for natural gas is similar, as low natural gas prices lead to a corresponding drop in shale gas drilling due to less profitability, which in turn reduces supply, and less supply tends to raise prices.

Container-on-Vessel

¹⁴ U.S. Energy Information Administration. Web June 20, 2014. <http://www.eia.gov/forecasts>

¹⁵ U.S. Energy Information Administration. Web June 20, 2014. <http://www.eia.gov/forecasts>

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Port authorities, government agencies and shippers look to the feasibility of container-on-vessel (COV) service to enhance existing truck and rail transport. COV is cost-effective for shippers in unit, operation and labor costs when compared to rail and truck. Potential obstacles to greater use of COV in Missouri include: readiness of ports, delivery requirements for ports to sustain service, and inefficiencies in backhauling empty containers. Most port authorities don't currently provide containerized cargo.

Initiation of COV service depends on the development of partnerships between key port operators and shipping stakeholders. According to "Missouri Public Port Authorities: assessment of importance and needs," all current port facilities, with limited capital investments, could operate as a COV facility.

Needs Input

In an effort to identify needs and issues affecting the efficient movement of freight in Missouri, information from a variety of sources was gathered and analysis was performed. In order to identify needs it is important to understand the current conditions of the freight system, which provides us with a snapshot of how freight moves today. The key inputs into identifying needs include: regional freight plans, stakeholder input, freight transportation system assets inventory and assessment, and analysis of the conditions and performance of the State's freight system.

Regional Freight Plans

Both the Kansas City and St. Louis metropolitan areas have regional freight plans in place. The Kansas City Regional Freight Outlook and the St. Louis Regional Freight Study both provide a forecast of growth in freight movements in Missouri on regionally defined freight networks. Each plan highlights improvement recommendations and needs in each region.

Kansas City Regional Freight Outlook

The Kansas City Regional Freight Outlook was produced in 2009 with the following regional objectives.

- Improve goods movement system performance
- Support transportation and logistics business attraction and retention
- Contribute to ensuring the region's quality environment

The plan focused on a number of critical actions to complete over a three- to five-year period, which covered through 2014. As a result, many of the recommendations have already been completed.

St. Louis Regional Freight Study

The St. Louis Regional Freight Study was completed in 2013 and identified strategic links to address connections between freight modes. These strategic links are:

- Water to Rail
- Truck to Water to Rail
- Rail to Rail (Intermodal)
- Repurpose Old Industrial Sites

The study noted some specific modal project recommendations and needs in the region. Rail improvement needs include rebuilding the western approach to the Merchants Bridge, adding a third mainline track from Grand Avenue to the MacArthur Bridge, and double-tracking the BNSF rail line under I-44. Trucking needs include additional capacity on the I-270 New Chain of Rocks Bridge, improved route signing for through trucks, ITS improvements to relay real time bridge congestion, and monitoring of truck heavy intersections and arterials near intermodal yards. Waterway modal

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recommendations include exploring container-on-vessel opportunities, reusing old riverfront sites for higher value manufacturing activities, and working with the private sector to move from high volume transload terminals toward more unit train capacity terminals. The study did not mention any project needs related to the air cargo services at Lambert-St. Louis International Airport.

Stakeholder Input

Due to the unique character and diversity of the freight industry, representation from the providers and users in all modes of the freight transportation system were necessary. This diverse group provided an opportunity to help identify key issues and opportunities in the freight system. To ensure adequate and appropriate engagement with the freight community, a variety of tools were utilized, including freight stakeholder interviews; motor carriers, shippers, and receivers surveys; and district freight forums and webinars. The following sections discuss the information gathered from the stakeholder involvement process to date, with continuing outreach efforts to follow.

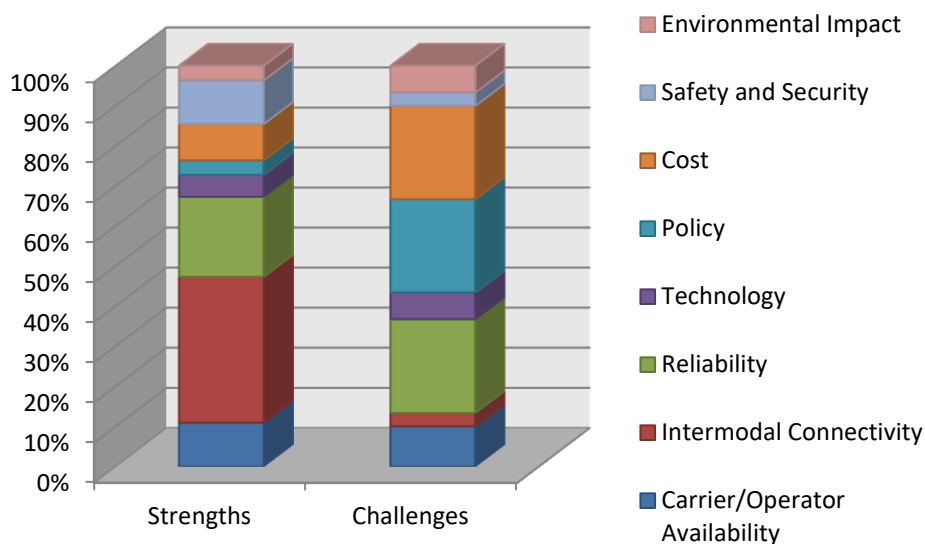
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Freight Stakeholder Surveys

The purpose was to solicit input, ideas, perceptions, concerns, and attitudes; and to identify key issues related to freight movement throughout the state.

A wide range of freight stakeholders, including trucking companies, railroads, and port authorities completed the survey. In total 31 surveys were completed, 21 (68 percent) of which were completed by representatives of the transportation and warehousing industry. Respondents of the survey indicated that the availability of several modal choices is the greatest strength of Missouri’s freight system and reliability, policy, and cost are the greatest challenges. **Figure 13** shows strengths and challenges that were identified.

Figure 13: Strengths and Challenges Identified by Freight Stakeholders



In addition, respondents to the survey were asked where they would spend money to improve the freight transportation system. Respondents provided a variety of answers to this question, the most frequent being:

- Improve the locks and dams
- Improve and expand port facilities
- Increase dredging
- Increase highway and railroad capacity
- Improve intermodal connectivity

Motor Carriers, Shippers, and Receivers Surveys

The Missouri Department of Transportation (MoDOT) began engagement efforts for the State Freight Plan in December 2013, targeting key business and community stakeholders. MoDOT identified 96 contacts in freight-related services including manufacturing, economic development, logistics, and carriers. An email invitation announcing the project was distributed with the Plan fact sheet to familiarize stakeholders with the launch of the Plan and the consultant team followed up with phone

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interviews. In total, 53 interviews were conducted. The statewide themes heard by the stakeholders include:

- Missouri is a “crossroads for the continent”. Missouri’s central location in the United States was consistently identified as a top strength of the state’s freight system and an asset for attracting new business. The state utilizes all of the different freight modes, and many stakeholders considered freight diversity to be another strength of the network, as long as all of the options are working together. Cooperation between modes is reported to be “relevant nationally”.
- Interviewees’ freight needs focused on Interstates and railroads. Across all freight services, discussion centered on trucks and rail. Although I-70 does not pass through every district, the majority of stakeholders indicated capacity upgrades from Kansas City to St. Louis are needed to maintain network reliability. Several other Interstate routes, including I-44, were also mentioned as key corridors for continued investment. Manufacturers also heavily utilize rail and want to see this mode continue to operate efficiently, but understand the challenge of planning for an asset that is owned and operated by private entities.
- An opportunity exists for ports to provide increased capacity and alleviate congestion in other modes, but ports require additional investment. Several stakeholders see potential for growth on the Missouri and Mississippi Rivers, but consistently brought up concerns including infrequent dredging and lack of improvements to the lock and dam system. The Panama Canal expansion was also mentioned by some stakeholders who want to make sure the state is positioned to take advantage of increased freight flow
- Stakeholders were interested in public-private partnerships to fund freight infrastructure improvements and incentives to attract new business. Business and community leaders were also asked what strategies Missouri could utilize to promote freight transportation. “Competing states are bringing resources to the table” was mentioned several times, and interviewees want Missouri to be in a position to remain competitive. Many stakeholders indicated cost-sharing initiatives with private freight networks and providers (rail, waterways, pipelines) would enhance economic development and that public freight networks (roads) should pay for roadway maintenance and capacity upgrades. Stakeholders across all freight services were concerned about the availability of funds for future investment.

District Freight Forums and Webinars

Seven district freight forums were held throughout the state. The purpose of the forums was to ensure that the perception of the freight trends, needs, and issues are understood and to expand the dialogue that was started as part of MoDOT’s long range transportation plan. **Table 12** lists the date and location of each forum that was held. Around 150 stakeholders participated in the District Freight Forums. Due to weather, the Hannibal in-person forum was cancelled and a webinar was held to present the information and receive input.

Table 12: District Freight Forums

District	Date	Location
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Central	January 29, 2014	Jefferson City
Northwest	January 30, 2014	St. Joseph
Kansas City	January 31, 2014	Kansas City
Northeast	February 4, 2014	Hannibal
St. Louis	February 6, 2014	Chesterfield
Southwest	February 7, 2014	Springfield
Southeast	February 25, 2014	Sikeston

Recurring themes heard during the forums from across the state include:

- Missouri generally has a well-connected and functioning road network until there is a hiccup, such as congestion, weather, or construction. Stakeholders also identified a need for capacity and maintenance improvements to maintain reliability of Interstates and minor routes.
- I-70 is a vital transportation link for the State and needs to be improved across the State.
- Missouri is a “crossroads for the continent” and has a vast freight network that is an asset for retaining existing businesses and attracting new business. Stakeholders voiced concern that not all modes are readily accessible and well connected with other modes (e.g. rail to water ports) and that work needs to be done to integrate the freight modal networks.
- There is a need to engage additional stakeholders to help guide the freight plan. Previous efforts have lacked private sector engagement. Over the last several years MoDOT has collaborated with several private sectors groups on successful projects. This is an opportunity to build on those relationships, share information, and continue to collaborate.
- Investigate possibilities for utilizing waterways. Stakeholders see potential for growth on the Missouri and Mississippi Rivers but consistently brought up concerns including frequency of dredging, lack of improvements to the lock and dam system and inconsistent water levels. The expansion of the Panama Canal was also mentioned by stakeholders who want to make sure the state is positioned to take advantage of potentially increased freight flow and remain competitive. Stakeholders are concerned about low water levels and the impacts to operations if dredging frequency decreases.
- Appropriately funding freight transportation projects is a key stakeholder concern. Stakeholders voiced a need to preserve the existing freight network and systems, but also said that improvements and enhancements are key to growing the state’s economy.

The following sections provide a summary of the three to six key issues heard during each of the district forums.

Central

The following are the key items that were discussed during the Central District forum.

- Innovative funding options should continue to be explored. Stakeholders in this district are concerned that funding gaps are threatening programs that are working well, such as MoDOT’s cost share program.

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- Efforts should be made to improve connectivity throughout the district. Stakeholders identified a need for improving north-south connections and specifically noted concerns with US-63 between Jefferson City and Rolla. The district could also benefit from improvements to I-70, such as increased lanes, as the Interstate is critical to moving freight and supporting the agriculture industry. Several stakeholders suggested that a multi-modal hub between Columbia and Jefferson City would support economic development in the district.
- The Missouri River is underutilized and under-marketed. Stakeholders recognize that the district should expect increased demand over the next five years and beyond. Utilizing waterways will be critical in effectively moving additional freight and taking strain off of highways and rail lines.
- The freight system needs to support the agriculture industry, which is key to the economic success of the district and the State. As one stakeholder noted, “2014 ag industry technology is being moved on a 1940’s (freight) network.”

Northwest

The following are the key items that were discussed during the Northwest District forum.

- Farm-to-market routes are essential to the region’s economy. Rail access in this region is decreasing, so lettered routes are very important, not only for moving agriculture goods, but also as connections for manufacturers to highways and Interstates.
- Road capacity upgrades are important in the region. Despite I-70 passing outside of the district to the south, stakeholders indicated that it should be improved to a six-lane facility. Stakeholders also suggested increasing capacity to four lanes between I-29 and I-35 through Maryville.
- US-36 is an important corridor for business owners and should be considered for Interstate designation. One private truck freight fleet operator called US-36 a “national best-kept secret.” He explained that it is a safer route and that it saves his drivers an hour in drive time to Indianapolis.
- There is a dwindling rail presence in the district. Stakeholders pointed out that there were more freight rail options in the past and many of those options no longer exist in the district.
- Economic development efforts, such as the Eastowne Business Park in St. Joseph, need adequate roadway access. In addition, food industry businesses, such as Farmland Foods, could benefit from investment in intermodal access.
- Low water levels and water quality in the district and throughout the State concern stakeholders, as does local port funding.

Kansas City

The following are the key items that were discussed during the Kansas City District forum.

- The Kansas City community is proud of its status as one of the largest rail freight and trucking hubs in the country. Stakeholders commented that integrating different freight modes is important regionally and nationally. Assets in this district include a rapidly growing Foreign

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Trade Zone and the BNSF multi-modal facility located across the state line in Kansas, which will have the largest speculative space in the country.

- Capacity upgrades to I-70 are a top priority in the Kansas City District as well as across the State. The importance of the I-70 corridor to freight movement is echoed throughout all of the districts. Additional lanes were suggested to provide better reliability along the corridor. Other top priority corridors identified included I-44 and the south leg of I-435.
- Private sector engagement is a crucial part of crafting a meaningful freight plan. Stakeholders suggest that key businesses, including railroads, should be brought into crafting the plan and that the best way to do that is through cultivating relationships and building trust. In addition, information on private sector freight movements that has not been available in the past is needed for a complete freight picture and a plan that enhances economic development in the State.
- The increase in the use of e-commerce is changing the way that freight stakeholders conduct business and will require a freight system that accommodates that shift. Stakeholders pointed out that more distribution centers will lead to greater pressure on roadways.

Northeast

The following are the key items that were discussed during the Northeast District forum.

- Capacity expansion and maintenance of highway networks are essential to ensuring network reliability. Specific examples of maintenance issues provided by stakeholders included US-36 from Shelbina to Hunnewell and Monroe City and along US-61 between Palmyra and Hannibal. Road surfaces in many sections are “rougher than a cob.” Capacity issues include too much truck traffic on I-70, and bottlenecks on US-61 in Hannibal and on the I-70 interchange in Warrenton.
- Future growth is threatened by railroads closing local crossings and spurs and removing scales in this district.
- Locks and dams along the Mississippi River need improvement. Port stakeholders in this region mentioned the deteriorating condition of the lock and dam system as a challenge for Missouri freight in the future.

St. Louis

The following are the key items that were discussed during the St. Louis District forum.

- St. Louis is challenged to compete as a freight hub, and focus should be placed on developing opportunities for intermodal activities and international export. Stakeholders said transforming St. Louis to a major freight hub status is needed to grow the regional economy. While “St. Louis tends to be a pass-through,” there are opportunities to develop additional facilities, particularly as an alternate freight hub to Chicago, which is highly congested. Stakeholders would like the public to be better informed on how freight transportation infrastructure supports the economy and jobs.
- Congestion on I-70 and I-44 causes costly delays and some safety concerns.

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- It is difficult to move freight from ports and airports directly to destinations. Better connectivity is needed between the freight modes. Stakeholders are concerned about the difficulty businesses have in making the “last-mile connections.” This issue was recently raised when trying to attract large economic development deals to the region.
- Air cargo facilities are available at Lambert Airport, but they are dated and small.
- Deficient bridges in the district could cause costly delays and pose safety concerns for carriers.
- There is a shortage of available motor carriers and truck fleets as it is becoming increasingly difficult to recruit and insure drivers, and many fleets have left St. Louis. These shortages are driving up costs to move freight on roadways.

Southwest

The following are the key items that were discussed during the Southwest District forum.

- Interstate capacity upgrades are needed. Many stakeholders suggested adding lanes to I-70 and I-44. “I-44 is aging out and will need additional capacity as the population increases in the region.” Congestion on these Interstate corridors is a top concern for many, especially in urban areas. One stakeholder recommended completing I-49 to the Arkansas state line.
- Motor carrier accommodation and recruitment is a high priority in this district. A recurring theme from stakeholders is the need for better accommodations for motor carriers, such as improved and larger rest areas. In addition, stakeholders are interested in motor carrier recruitment, driver training programs for the general public to increase safety on roadways, and less regulation on drivers.
- Funding programs for freight should be flexible so each district can target their specific needs, regardless of mode.

Southeast

The following are the key items that were discussed during the Southeast District forum.

- East-west connectivity is limited regionally and a St. Louis bypass could help congestion. Capacity concerns in the St. Louis area led many stakeholders to suggest an east-west or diagonal corridor to provide “this area a direct route through central Missouri” as an alternative to the longer I-55/I-70 route. Another interviewee said Missouri “needs an ‘X’ through the middle of the state to connect southeast Missouri with Kansas City and Kirksville to Joplin and Springfield.” Stakeholders also suggested a freeway-type roadway (i.e. four-laning US-60 across the state).
- US-67 is a key north-south connection, and completing the route through Arkansas would increase economic opportunities.
- Industry relies on secondary highways for time-sensitive delivery and connections to Interstates, and the condition of these roadways could be improved. Several stakeholders suggested resurfacing and capacity upgrades.

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- Stakeholders are concerned about funding for ports and waters for small-level capital projects. Additionally, several stakeholders commented about the need for consistent support of dredging.

Needs Identified

Based on the results of the tasks discussed in the previous sections, this section identifies the key freight system needs. Through the analysis of these tasks, 28 general freight network needs were identified. The needs identified are discussed below by mode of freight transportation and fall into one of six categories: system capacity, system operations, freight network, safety, connectivity, and policy regulations.

Highway

The freight system needs identified for the highway mode of transportation include needs falling under five of the six categories listed above. The identified freight system highway needs are:

- Improved potential corridor capacity.
- There are bottlenecks throughout the State at a number of locations on the highway network. These bottlenecks can be caused by capacity issues, as well as geometric issues. Improvements are needed to eliminate these bottlenecks. The improvements will be dependent on the cause of the bottleneck. Bottlenecks could be both a capacity and operations issue. **Figure 2** in Section 2 Trends and Issues of this report shows the Top 100 bottlenecks in Missouri.
- Safety is a major focus of both public and private sector freight stakeholders. Key safety needs include: the lack of safe truck parking, numerous at-grade rail crossings, and roadway design and geometrics improvements to facilitate safety.
- Major freight generator sites have been identified throughout the State. Connectivity to these sites is a key need, including the last mile connections.
- Missouri does not currently have a designated freight network. A designated freight network is needed for all modes of freight transportation, including highways, and will be produced as part of the State Freight Plan.

Rail

The freight system needs identified for the rail mode of transportation include needs under each of the six categories listed above. The identified freight system rail needs are:

- There are congestion and capacity issues on numerous rail lines throughout the State. Improvements to the rail lines with congestion and capacity issues are needed.
- A bottleneck at the intersection of rail lines in the Kansas City area currently exists. Coordination with the rail companies that own these rail lines and a solution to eliminate this bottleneck is needed.
- At-grade rail crossings throughout the State present a safety issue. Improvements at all at-grade rail crossings with safety issues are needed.

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- In the Northwest and Northeast Districts, short line rail lines are being removed and hindering economic development in these areas. Coordination with the short line rail companies is needed and a different solution than removal of rail lines is needed.
- At the Howard/Cooper Regional Port and Mississippi County Port, rail access to and from these ports is needed.
- There are two bridges across the Mississippi River in St. Louis and both are in poor condition. So while there is redundancy in the system the condition of the bridges presents a problem. The condition of both of these bridges needs to be improved.
- Currently because of a regulatory and inspection issue all refrigerated goods must be shipped through Kansas City, no matter the goods final destination. A proper inspection facility to meet the regulations is needed in St. Louis to eliminate the need to ship all goods through Kansas City.
- Missouri does not currently have a designated freight network. A designated freight network is needed for all modes of freight transportation, including rail.

Air

The freight system needs identified for the air mode of transportation include needs under three of the six categories listed above. Needs related to system operations, freight network, and policy regulations were identified for the air mode. The identified freight system air needs are:

- The cargo facilities at the St. Louis Airport (STL) are limited and outdated. These facilities need updated and expanded.
- The safety and perimeter security at the Kansas City International Airport (MCI) is in need of additional and improved fencing and gates. These security measures need to be updated and expanded. The Springfield Airport (SGF) has been identified has an airport that may have its tower hours reduced. The tower hours at SGF should not be reduced.
- Missouri does not currently have a designated freight network. A designated freight network is needed for all modes of freight transportation, including air.

Water

The freight system needs identified for the water mode of transportation include needs falling under four of the six categories listed above. No needs related to safety or connectivity was identified for the water mode. The identified freight system water needs are:

- At ports throughout the State increased maintenance activity is needed on both the land and water sides of the operations.
- Upgrades and rehabilitation are needed on many of the locks and dams in the State. Coordination with the US Army Corps of Engineers will be needed in order to do so.

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- Missouri's position is the Missouri River water flow needs to maintain navigation depth for the entire shipping season along the entire river. This plan and its elements should support the State's position.
- Numerous emerging ports have been identified throughout the State. Support for their development is needed.
- Missouri does not currently have a designated freight network. A designated freight network is needed for all modes of freight transportation, including water.

Pipeline

The freight system needs identified for the pipeline mode of transportation include needs under three of the six categories listed above. Needs related to system capacity, freight network, and policy regulations were identified for the pipeline mode. The identified freight system pipeline needs are:

- More pipelines across the State are needed to meet the demands of the energy sector activities.
- Missouri does not currently have a designated freight network. A designated freight network is needed for all modes of freight transportation, including pipeline.

Intermodal

The freight system needs identified for intermodal facilities include needs falling under four of the six categories listed above. No needs related to system operations or safety was identified for intermodal facilities. The identified freight system intermodal needs are:

- New intermodal connection points are needed.
- Improved intermodal connection ports are needed to ports across the State.
- Last mile intermodal connections are needed.
- Missouri does not currently have a designated freight network. A designated freight network is needed for all modes of freight transportation, including intermodal facilities.

Financing

The majority of Missouri transportation funds come from the gas taxes which have not been raised since 1992 and are constitutionally limited to State roads and bridges. This has put a severe strain on the transportation sector to find alternative funding sources. There is need to identify innovative and alternative funding sources. Missouri has one of the lowest state fuel taxes in the nation. This, coupled with Missouri having the seventh largest state highway system in the United States, which is made up of approximately 33,700 miles of roadway, has created project funding challenges for the leaders of Missouri. Missouri port authorities have no sustained, dedicated, reliable funding sources.

Conclusions

The purpose of identifying major trends and issues likely to impact freight transportation in Missouri in the foreseeable future is to provide additional information about the future that traditional forecasting

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techniques would likely overlook. Looking at several trends to track and monitor issues with the potential to have the greatest impact on freight in Missouri, such as infrastructure preservation and logistics, will enable MoDOT to plan and respond more effectively and create a transportation system prepared for the future.