



URBAN AND RURAL FREIGHT INTERDEPENDENCE: CHALLENGES AND OPPORTUNITIES IN MINNESOTA

White Paper

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Executive Summary

This white paper provides a brief overview of freight activities in Minnesota. It mainly focuses on the interdependence of rural and urban freight movement and the value of a well-connected freight network. It largely considers the seven-county Twin Cities metro area as entirely urban and the rest of the Minnesota region (or Greater Minnesota) as rural. This white paper aims to help audiences better understand the interdependence of rural and urban freight activities in the state and the benefit and value of freight investment to all Minnesotans.

Minnesota has a diverse economy that includes business entities from professional services, agriculture, manufacturing, health care, trade, utilities, mining, and many others. As of 2020, it is the official home to 16 Fortune 500 companies. This diversity makes the Minnesota economy more resilient than other Midwestern states. A vibrant transportation system supports economic competitiveness by providing needed jobs and keeping business in the region. Connectivity, mobility, and accessibility of a transportation system are considered critical factors for development by many businesses in the region. Companies rely on the freight transportation network to distribute their products to customers and receive raw materials needed to manufacture items. Without a safe, efficient, reliable, and robust freight transportation system, many residents would not have access to the goods and materials they need to live, work, and recreate.

Trucks carry a majority of freight on roadways to river ports, airports, rail yards, distribution centers, and multimodal freight facilities. Railroads in the state link other modes of transportation and carry commodities to national and international markets. Mineral raw materials, salt, fertilizer, and agricultural products are transported by water across the Great Lakes or along the river. A relatively small portion of freight value is carried by pipeline and air cargo.

The Minnesota Department of Employment and Economic Development has divided the entire state into six regions (southeast, southwest, central, northwest, northeast, and Twin Cities metro) for economic development and planning purposes. The business ecosystem in each region is inseparably connected by the road network and infrastructure.

For example, expansion of the Destination Medical Center (DMC) in the Rochester area and growing manufacturing industries in the southeast region will attract investment opportunities and employment to support economic growth in the area during the next two decades. U.S. Highway 52 is the key freight corridor connecting DMC to Minneapolis–St. Paul International Airport and the Twin Cities metro within 90 minutes. The influx of new jobs in this region will generate additional traffic demand for freight movement to support logistics and supply-chain operations. In addition, the medical devices industry relies heavily on express air freight shipments to deliver its products in a timely manner to domestic and international customers.

Southwest Minnesota is a national leader in agricultural production and renewable energy. Several large-scale wind farms with massive and powerful wind turbines were built to harvest renewable energy in this region. Wind turbine equipment often is transported from the Port of Duluth to and from wind farms and manufacturing facilities in southwestern Minnesota.

Central Minnesota has large concentrations of food manufacturing and fabricated metal product manufacturing. Because of the heavy reliance on truck transportation in the region, the highway system is paramount to the efficient movement of freight. Motor carriers use the highway system to transport products to consolidation points and intermodal freight facilities. For example, transport of milk and other dairy products in Stearns County mainly relies on key freight corridors to carry goods to, from, and through the Twin Cities area.

In the northwest region, transportation equipment and machinery parts arrive at manufacturing facilities primarily by truckload shipments. Business relies on key freight corridors to bring their products to the market. For example, Digi-Key Electronics typically processes more than 3 million orders annually, with nearly all orders shipped on the same day. Shipping is done primarily through common carriers, with about 80% of products shipped by truck and about 20% by air.

The northeast region is well-known for its soft-ore iron mines, which produced a significant portion of the world's iron ore for more than a century. Most of the iron ore is transported to steel mills by ship across the Great Lakes. Canadian National Railway (CN) handles most of this product on its lines to Two Harbors and Duluth, where it operates three ship loading docks.

The Twin Cities metro area is the primary freight hub for Minnesota and the Upper Midwest region. It is the major distribution center for goods produced and consumed in Minnesota, Wisconsin, North and South Dakota, and eastern Montana. Retailers, such as Target, Best Buy, and Supervalu, rely primarily on trucks to distribute grocery and consumer products to neighborhood stores in both urban and rural locations. Ports and multimodal facilities along the river handle barges — loaded with crops, fertilizer, and salt — transporting to and from the south.

Manufacturers position their factories in rural or urban areas to leverage their strength, value, and resources for cost-effectiveness, business development, and economic growth. They heavily depend on the existing transportation network that connects ports, terminals, distribution centers, and intermodal facilities to thrive and be successful. Traffic congestion, road conditions (pavement, shoulders, signs, etc.), and delays caused by construction are concerns to the logistics and supply-chain operations of private industry.

The freight infrastructure network enables efficient transport of goods and products to fulfill various aspects of business and consumer needs in the state and the Upper Midwest region. Freight movement, regardless of mode and where in the state it came from or went, is the backbone of the Minnesota economy. The diverse Minnesota economy and its future success

depend on a sustainable freight infrastructure that effectively connects urban and rural ecosystems for further economic growth and advancement.

Introduction

The Minnesota freight transportation system plays a critical role in supporting the region's economic competitiveness and quality of life [1]. Without a safe, efficient, reliable, and robust freight transportation system, many residents would not have access to the goods and materials they need to live, work, and recreate. Businesses rely on the freight transportation network to distribute their products to customers and receive raw materials needed to manufacture items.

This white paper provides a brief overview of freight activities in Minnesota. It mainly focuses on the interdependence of rural and urban freight movement, and it examines the challenges and opportunities facing all stakeholders in working together. People may have their own idea and definition of "rural" based on their perceptions — one person's small town could be another person's weekend city shopping hub. In this white paper, we largely consider the seven-county Twin Cities metro area as entirely urban and the rest of the Minnesota region (Greater Minnesota) as rural.

This white paper aims to help policymakers better understand the interdependence of rural and urban freight activities in Minnesota, to emphasize the value of the freight network, and to understand the benefit and impact of freight investment to all Minnesotans.

Background

Minnesota has a diverse economy that includes business sectors from professional services, agriculture, manufacturing, health care, trade, utilities, mining, and others. As of 2020, it is the official home to 16 Fortune 500 companies. This diversity makes the Minnesota economy more resilient than other Midwestern states. The economic diversity of Greater Minnesota mirrors the economic diversity of the Twin Cities metro area, except the Twin Cities metro doesn't have agriculture or mining [2].

The Minnesota transportation network, ranked fourth highest in 2019 for transportation infrastructure [3, 4], connects the Upper Midwest region to both national and global markets. Minnesota has fostered an export-oriented business culture since the arrival of railroads in the 19th century, which connected Great Plains farmers and Minneapolis flour mills to global markets [5]. This transportation infrastructure enables Minnesota-based companies to export goods to more than 200 countries. According to Minnesota export data, export of manufactured goods over the past two decades has risen as a percent of total state GDP, from 5.4% to 6.2%. Exports from Minnesota grew 10%, to a new all-time high of \$23 billion in 2018, outpacing national export growth [6-11].

The existing transportation network plays a vital role for Minnesota businesses to stay competitive in reaching both domestic and international markets and delivering their products or services efficiently. Interstates and state and local highways host trucks carrying commodities to and from our communities. Trucks carry freight on roadways to river ports, airports, rail yards, distribution facilities, and multimodal freight facilities. Four Class I and 17 short-line railroads operate in the state, linking other modes of transportation and carrying commodities to national and international markets [5]. In the northeast region, iron ore, coal, grain, cement, salt, steel, and limestone are shipped on the Great Lakes to national and international markets through the ports on the western shore of Lake Superior. These ports and terminals on navigable Minnesota rivers transport agricultural and other products to the South and the Gulf of Mexico.

Here is an example to better understand the urban and rural freight interdependence and how milk gets from cow to local store. After harvesting, milk directly from the cow is temporarily stored on the farm in a huge cooling container to keep it fresh. The farmers use tanker trucks to transport the milk to the processing factory. When milk enters the processing plant, it can go into the evaporation and drying process to become powder, or it becomes fluid milk. Whole milk, once approved for use, is pumped into storage silos where it undergoes pasteurization, homogenization, separation, and further processing before it is ready to be packaged. Packaged milk usually is carried by trucks to regional food distribution centers and then delivered to local grocery stores. Each family directly and indirectly relies on transportation services to provide food on the table.

Freight flow between rural and urban regions

According to 2018 Freight Analysis Framework (FAF) data [12], the majority of freight between rural and urban areas in Minnesota is carried by truck. About 93% of freight (by weight and value) movement from rural Minnesota to the Twin Cities metro is carried by truck (see Figure 1). Rail carries about 7% of freight by weight and 4% by value. Other agriculture products and cereal grains are the major commodities carried by truck. Similarly, rail carries mostly cereal grains and wood products from rural to urban areas.

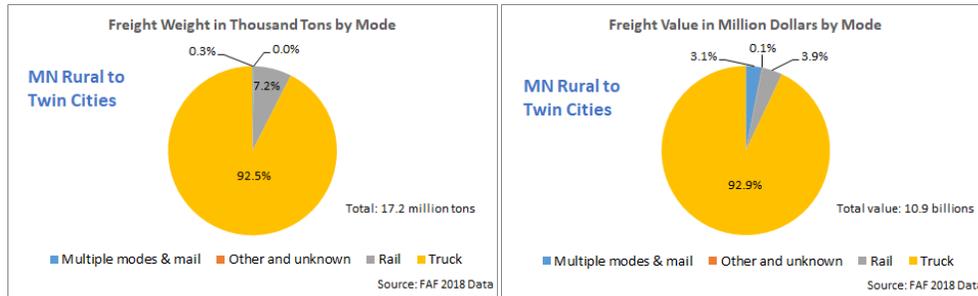


Figure 1. Distribution of in-state freight movement from rural to Twin Cities metro area by mode

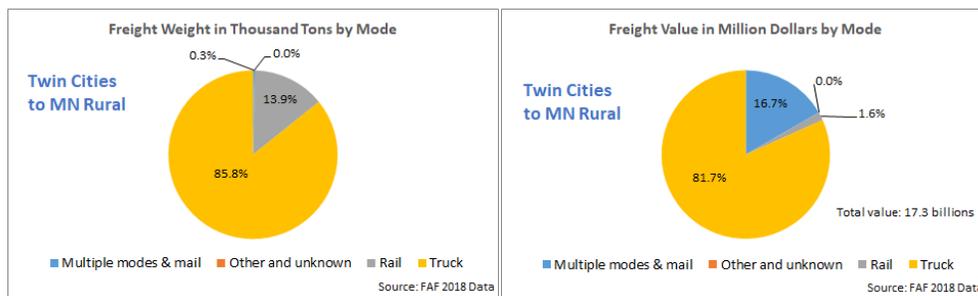


Figure 2. Distribution of in-state freight movement from Twin Cities to rural area by mode

For freight movement from the Twin Cities metro area to rural areas, about 86% of freight by weight and 82% by value is carried by truck. About 14% of freight by weight and 2% by value is carried by rail (see Figure 2). Trucks carry mostly cereal grains and other agriculture products, and rail carries mostly metallic ores and cereal grains to Greater Minnesota. In addition, about 17% of freight by value is carried by multiple modes from urban to rural areas.

Lower levels of freight within Minnesota are carried by water and air compared with trucking and rail. Shipments reported as multiple modes can include anything from containerized cargo to coal moving from mine to railhead by truck and rail to harbor. The “mail” component recognizes that shippers who use parcel delivery services typically do not know what modes were involved after the shipment was picked up.

Traffic Congestion

Traffic congestion is a persistent issue and a growing obstacle to trucking operations. Congestion on U.S. highways costs the trucking industry more than \$63 billion annually in operating expenses [13]. In 2017, truck congestion cost the Twin Cities metro area around \$217 million [14]. Though the Twin Cities ranked the fourth lowest for commute time to work among the 30 largest U.S. metros [10], it had five highway interchanges (I-35W at I-494, I-35E at I-94, I-35W at I-94, I-35W at I-694, and I-94 at U.S. 52) on the list of top 100 truck bottlenecks in the nation in 2019, according to the American Transportation Research Institute [15].

The 2018 Minnesota statewide freight system and investment plan [16] laid out a policy and strategic framework to guide future freight planning and investment. The plan has identified performance measures in safety, infrastructure, and mobility to improve mobility, preserve the infrastructure, and support the Minnesota economy. But local agencies and private industries express concerns about the highway investment priority that it might be biased without the consideration of freight activities.

Business Priorities and Challenges

Transportation is a critical consideration for many businesses in the region. Rough pavement, congestion, and poor connections from major highways to final destinations all are factors that affect business transportation costs. In the freight and logistics industry, congestion shrinks the delivery area that a vehicle can serve. As a result, business needs to have more vehicles on the road to maintain the distribution coverage. Traffic congestion is changing the freight delivery and operational decisions of businesses and increasing their costs.

To ensure timely movements of goods, businesses need to be able to efficiently and reliably access a transportation network that may include a terminal on the Minnesota River, the airport, a warehouse loading facility, a railroad siding, or a multimodal facility. Reducing distribution costs through an enhanced freight system that operates more reliably and efficiently can ultimately enable businesses to price products more competitively for the benefit of consumers.

Minnesota business relies on the regional freight transportation system to distribute products to domestic and international markets. Congestion delays on the roadways and at intermodal terminals affect regional economic competitiveness and incur additional costs on the supply chains and truck-dependent businesses. As traffic volumes and congestion grows on highways and urban roadways, the cost of freight and delivery service increases, and it becomes more challenging for operators to maintain dependable and reliable schedules.

Since 2013, MnDOT has conducted studies in several districts to better understand business transportation needs [17]. The findings outlined transportation challenges that manufacturers are facing in infrastructure, safety, cost-effectiveness, dependability, accessible information, and policy.

The agricultural industry would like to see more roads with wider, paved shoulders for the farming equipment. Manufacturers need a smoother road for their operations. Rough roads present a perceived risk to driver safety, cause potential damage to products, and increase vehicle wear and tear. Though road improvement projects are appreciated, it also would be helpful to provide better signage, provide coordination among state, counties, and cities to minimize detour impact during constructions, and provide communications in advance to businesses regarding construction to avoid costly delays. In addition, there are concerns about bridge clearance, design of roundabouts that are not able to accommodate oversized vehicles, weight and size restrictions, and federal hours- of-service regulations for truck operators.

The freight-rail industry consists of several privately owned and operated companies. The modern rail system implements precision-scheduled technology to reduce operating cost ratios and improve freight operation efficiency. As compared with trucking, it strives to be more fuel-efficient and environmentally friendly. In fact, the freight-rail industry has a very robust competition with trucking, but it usually is not as consistent, mostly due to dependence on agriculture in western Minnesota. Unlike the trucking industry, however, the freight-rail industry does not have the capability to track freight packages when on the rail, which is a disadvantage. The increasing cost of liability insurance is another concern to the freight-rail industry. In addition to some robust programs offered by the federal government, the rail industry would welcome policymakers and transportation planners to consider the value and safety perspectives that rail freight provides the general public.

Interdependency of Rural and Urban Ecosystems

Health care, manufacturing, agriculture, mining, energy production, and services are the major industries in Minnesota. Minnesota also is the largest U.S. producer of sugar beets, sweet corn, and green peas for processing and farm-raised turkeys. Minnesota manufacturers and farmers primarily rely on trucks to transport freight on roadways. Those include long-haul trucks traveling through the region and to river ports and rail yards as well as direct truck service to distribution facilities and freight-generating industries, such as manufacturers and processing plants, and deliveries to businesses and consumer households.

Minnesota medical device businesses and linked industries in the state illustrate this urban and rural interdependency. A spatial analysis (see Figure 3) revealed that medical device companies were highly concentrated in the Twin Cities metro area while businesses in linked industries are more broadly dispersed among the 80 counties of Greater Minnesota [18].

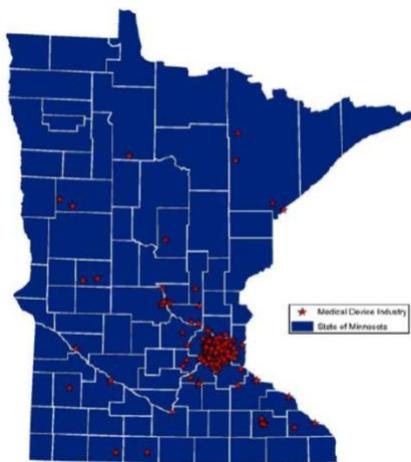


Figure 3a. Medical device companies

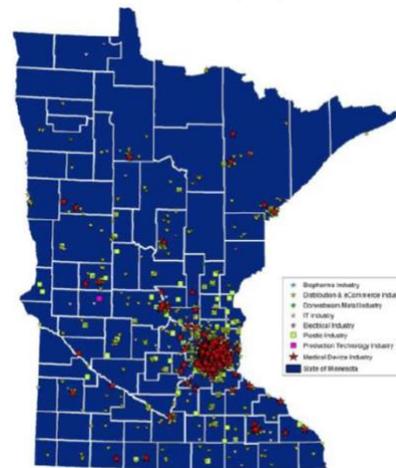


Figure 3b. Medical device-linked industry

Source: Munnich et al. [18]

The Minnesota Department of Employment and Economic Development divided the entire state into six planning regions (southeast, southwest, central, northwest, northeast, and Twin Cities metro). The following subsections summarize the economic strength of each region and its connection with the regional freight network.

Southeast Minnesota Region

Health care, manufacturing, and government are the largest industry employers in the southeast region of Minnesota [19]. It is second only to the southwest region as the largest supplier of agricultural products. Expansion of the Destination Medical Center (DMC) in the Rochester area [20] and growing manufacturing industries in the southeast region may attract investment opportunities and employment to support economic growth in the area during the

next 15 to 20 years. U.S. Highway 52 is the key freight corridor connecting DMC to Minneapolis–St. Paul International Airport and the Twin Cities metro within 90 minutes. The influx of new jobs in this region may generate additional traffic demand for freight movement to support logistics and supply-chain operations.

Intermodal facilities in the Winona area are established with two Class I railroads originating from transloading centers. Commodities are shipped and received via rail or truck using both Canadian Pacific and Union Pacific rail transportation assets. In addition, corn and soybeans from area farmers are hauled by trucks to load on barges that proceed downriver to Louisiana for international markets.

Southwest Minnesota Region

Southwest Minnesota is a national leader in agricultural production and renewable energy. In 2019, manufacturing and health care were the top two largest employing sectors in southwest Minnesota [21]. Truck transportation supports the manufacturing industry (such as food processing, machinery, and others) to produce and ship goods and provide services to consumers. It provides more than half of the transportation and warehousing industry jobs in southwest Minnesota [22]. In addition, several large-scale wind farms with massive and powerful wind turbines were built to harvest renewable energy in the region. Wind turbine equipment (both blades and tower sections) is moving frequently from the Port of Duluth to and from wind farms and manufacturing facilities in southwestern Minnesota.

Central Minnesota Region

Health care, manufacturing, and retail trade are the top three employing industries in central Minnesota [23]. Central Minnesota has large concentrations of food manufacturing and fabricated metal product manufacturing, as well as significant amounts of machinery and transportation equipment manufacturing. Like other regions in Minnesota, a major portion of freight in this region is carried by truck. Because of heavy reliance on truck transportation in the region, the highway system is paramount to the efficient movement of freight. Motor carriers use the highway system to transport products to consolidation points and intermodal freight facilities [24]. For example, Stearns County [25] is the top Minnesota dairy county and 21st in the nation for its “value of sales” in milk and other dairy products from cows. Transport of milk and other dairy products relies on key freight corridors, such as Trunk Highway 23, Trunk Highway 24, and I-94, to carry goods to, from, and through the Twin Cities area.

Northwest Minnesota Region

Manufacturing is the second largest industry behind health care in northwest Minnesota. For example, Polaris Inc., headquartered in the Twin Cities, was founded in Roseau, where it still does engineering and manufacturing. Agriculture in this region also generates the second highest market value of agricultural products among the six planning regions in the state. Food manufacturing is the largest industry sub-sector in the northwest, followed by transportation equipment manufacturing, machinery manufacturing, and fabricated metal product manufacturing [26, 27].

Transportation equipment and machinery parts arrive at manufacturing facilities in this region primarily by truckload shipments. Some truckloads are transloaded from rail to truck at yards in Minneapolis and St. Paul. Some finished products are trucked to Minneapolis and St. Paul, then loaded onto rail bound for east or west coast ports, depending on the export market [28].

Business relies on key freight corridors, U.S. Highway 2, U.S. Highway 59, Minnesota 32, U.S. Highway 71, and Minnesota 11, to bring their products to the market. For example, Digi-Key Electronics, headquartered in Thief River Falls, has an increasing worldwide customer base, with nearly half of its customers located outside the United States. The company typically processes more than 3 million orders annually, with nearly all orders shipped on the same day. Shipping is done primarily through common carriers, with about 80% of products shipped by truck and about 20% by air [29].

Northeast Minnesota Region

In recent years, health care and retail trade have become the two largest employing industries in the northeast region of Minnesota [30]. This region is well-known for its soft-ore iron mines, which produced a significant portion of the world's iron ore for more than a century. Most of the iron ore is transported to steel mills by ship across the Great Lakes. Canadian National Railway (CN) handles most of this product on its lines to Two Harbors and Duluth, where it operates three ship loading docks.

In 1910, 3M (formerly Minnesota Mining and Manufacturing Co.), a diversified manufacturer of industrial and consumer products, moved its headquarters from Duluth to St. Paul, which led to faster expansion of the company due to a more central location [31].

Twin Cities Metro Region

The Twin Cities metro area is the primary freight hub for Minnesota and the Upper Midwest region. It is the major distribution center for goods produced and consumed in Minnesota, Wisconsin, North and South Dakota, and eastern Montana [32, 33]. Retailers, such as Target, Best Buy, and Supervalu, rely primarily on trucks to distribute grocery and consumer products to neighborhood stores in both urban and rural locations. The Twin Cities contain only 12% of the centerline mileage in the state but account for 47% of vehicle miles traveled annually. Companies would like to stay competitive by saving travel time and fuel consumption. Traffic congestion and travel-time reliability in the metro area raise concerns for the freight industry.

For example, Trunk Highway 13 provides the main access to the Ports of Savage, located by the Minnesota River in Scott County. Each year, the multimodal facility handles barges loaded with fertilizer and salt from the south. The port terminal also holds crops (corn and soybeans) brought by farmers in trucks, stored, and then sent downriver on barges to New Orleans. From there, the product goes out on the Gulf for export.

The Ports of Savage have a major congestion issue that started in the late '90s. It is challenging to get products to the port with the limited space, a railroad crossing, traffic signals, and increasing truck volumes during peak season. Farmers, companies, and local government have expressed a need to address safety, access, and mobility issues within the Trunk Highway 13 corridor to improve freight movements in the Ports of Savage area.

Value of Freight Improvement

Freight improvement and investment on corridors that connect urban and rural regions provide significant value to economic growth in the region. Freight improvement projects yield both direct and indirect benefits. Direct benefits include saving on travel time and operational costs, decreasing vehicle emissions, and improving ambient air quality. Indirect benefits include additional employment opportunities and support for regional economic growth.

The Minnesota Highway Freight Program (MHFP) has selected 14 freight improvement projects [34] from 2019 to 2022 (Figure 3). For example, the I-35, I-535, and U.S. Highway 53 Twin Ports interchange reconstruction in Duluth area, when completed in Fall 2023, will help reduce freight congestion and improve efficiency. The project is eliminating blind merges and left exits, replacing aging infrastructure, and better accommodating freight movements through the interchanges next to the Clure Public Marine Terminal [35].

In Dakota County, the County Road 70 expansion project [36] will upgrade the three-lane county road to a four-lane divided roadway. When completed in 2021, the improvement will add capacity and reduce delays for a major truck route and area noted for business growth. In 2022, Highway 13 port access and mobility improvements in Scott County will start to address truck congestion and accessibility issues in the Ports of Savage area.

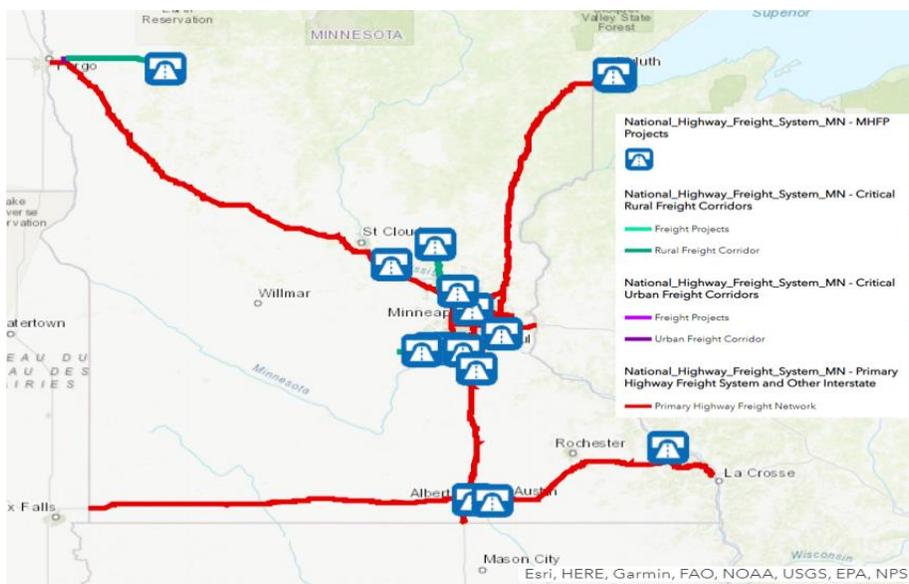


Figure 3. Map of MHFP projects selected in 2018 [37]

Opportunities

Freight safety, mobility, accessibility, connectivity, and cost-effectiveness are often the major criteria in prioritizing freight improvement projects. Performance measures corresponding to these criteria are relatively straightforward to obtain from available traffic data. However, these criteria may be biased towards freight investment in urban regions due to the higher density of population, a busier transportation network, and frequent freight transport activities. The interdependence between urban and rural regions in freight economics could include traffic performance metrics and economic indexes. It could embrace a broader perspective of benefits and value added to the region by freight improvement projects.

In addition, there is an opportunity to be sensitive to industry needs when building new projects or improving existing infrastructure. For example, Chart Industries [38], a unique industry in New Prague, manufactures gigantic cryogenic equipment. Huge containers are very difficult to transport due to bridge clearance and other roadway restrictions. It usually takes about eight hours to transport the product from New Prague to the port in Savage where the equipment is barged south to New Orleans, then to international customers.

Conclusion

Minnesotans rely on a safe, efficient, reliable, and robust transportation network to access the goods and materials they need to live, work, and recreate. The freight system plays a vital role in enabling private companies to distribute their products to customers and receive raw materials needed for manufacturing. Trucks carry a majority of freight on roadways to river ports, airports, rail yards, distribution facilities, and multimodal freight facilities. Railroads in the state link other modes of transportation and carry commodities to national and international markets. Mineral raw materials, salt, fertilizer, and agricultural products are transported by water across the Great Lakes or along the river. A relatively small portion of freight value is carried by pipeline and air cargo.

Stories of the origins of 3M and Polaris illustrate as part of Minnesota heritage that hometown businesses are preferred and established despite geographic location. Manufacturers position their facilities in rural or urban areas to leverage their strength, value, and resources for cost-effectiveness, business development, and economic growth. They heavily depend on the existing transportation network that connects ports, terminals, distribution centers, and intermodal facilities to thrive and be successful. The freight infrastructure network enables efficient transport of goods and products to fulfill various aspects of business and consumer needs in the state. For example, Amazon recently announced its plan to open 1,000 warehouses in suburban U.S. neighborhoods to provide prompt service to their customers [39]. The topic of an interdependent freight network is critical and will remain so.

Traffic congestion, road conditions, and delays caused by construction are concerns to manufacturers, freight carriers, and farmers. Traffic congestion can be a key economic factor for facility location and affect manufacturing growth.

Freight movement, regardless of mode and where in the state it came from or went, is the backbone of the Minnesota economy. The diverse Minnesota economy and its future success depend on a sustainable freight infrastructure that effectively connects urban and rural areas to support further economic growth and advancement. The history and current trends in the movement of rural and urban freight indicates that we need to prepare our interconnected freight system to meet the demands of the next decade.

We all share a joint future that needs to be properly managed to ensure a prosperous tomorrow. Looking forward, here are several topics for consideration to address future freight needs and support economic growth in Minnesota.

- Develop a vision for our future freight system
- Develop a plan to sustain future freight system in the next decade
- Explore the impact of congestion on competitiveness
 - Congestion will increase labor, operating, and capital costs for the freight industry. It also places constraints on business location and scale economies.
 - Opportunity to use technologies to better manage traffic flow and prioritize freight traffic
 - Future impact of electric and autonomous vehicles
- Prioritize future investments based on limited resources
- Opportunity to take into account the more efficient projects that alleviate congestion
- Facilitate the interconnection and interdependence of rural and urban freight movement

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About MFAC

The Minnesota Freight Advisory Committee (MFAC) was established in 1998 to advise the Minnesota Department of Transportation (MnDOT) and other public agencies and officials on the performance and importance of Minnesota's freight transportation system to support the state's economic competitiveness.

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