1. STATE OF THE SYSTEM: FREIGHT COMPONENT

Freight transportation is vital to the daily life of the people of Ohio and the prosperity of the State. Freight and logistics activity accounts for well over 100,000 Ohio jobs and appears in every county, but that is just a part of its importance. Virtually every item that our citizens own or use was carried to them by the freight system, from the food on the table and the electronics around the house, to the seed in the garden and the fuel in the car. The Ohio companies where they work are similarly reliant on freight. For many businesses, logistics are essential to how they compete - in service to markets and in costs to customers. This isn't just true for industry and agriculture. Distribution methods are a key strategy in consumer retail whether in stores or on-line. Ohio hospitals depend on freight carriage not only for timely supplies of everything from medicine to bed linen, but for keeping their costs down and their facilities free for patients instead of inventory storage. All of these aspects add up to a system as essential to us as the clothes on our backs, and as the foreign origin tags on many clothes reveal, the system supports us locally and globally.

Exhibit 1: Centers of Logistics Employment

Ohio freight also is a mainstay for the entire country. The state ranks generally sixth in the nation for its volume of freight shipped in or out, measured by tonnage or value of goods[1]. Traffic shipped through Ohio or between Ohio and other markets accounted for 70% of the state's tonnage and 87% of its freight value in 2007, and the through traffic alone represented 43% of tons and 58% of value. These figures demonstrate the significance of the state in the nation's commerce, both for the contribution of Ohio-based shipping and the volume borne for other states (as others bear Ohio's). The quality of the transportation system over which this traffic travels is reported strong by freight users contacted for this plan, and an asset for attracting and retaining business. Its powerful array of multimodal options is beneficial for many types of companies and the varied needs that many of them have: waterborne shipping by lakes and river, competitive air service including major facilities at Cincinnati and Columbus, and rail service from four Class I carriers and 31 others operating over 5,300 miles of track - the most per square mile in the country. With no sprawling metropolitan areas, Ohio freight congestion is not as punishing as other major states. While the roadway system is not without challenges and will face more with growth, shippers and motor

> "Few supply chain companies have been compelled to make network adjustments for Ohio deficiencies, and the cost of adjustments was largely negligible"
>
> – Tompkins Supply Chain Consortium

[1] FHWA Freight Analysis Framework, 2010. Ohio outbound traffic ranked 8th by tonnage but 6th by value, and inbound traffic ranked 6th by both measures.

carriers alike view Ohio as a good place for their operations. These are substantial advantages for the state to maintain and utilize.

This chapter describes the state of the Ohio freight system. It begins with a review of key points from a database of regional performance factors from a consortium of supply chain companies, and interviews with Ohio-based automotive manufacturers. It then presents an inventory of assets serving trucking, rail, marine, and air cargo modes, followed by a summary of economic trends and freight traffic patterns. Finally, highlights of future needs in the freight system lead to a thematic description of potential strategies the state may employ.

1.1 Stakeholder Insight Summary

Freight stakeholder insights were obtained from regional performance benchmarks maintained by the Tompkins Supply Chain Consortium, and direct interviews with original equipment manufacturers in the automotive industry operating in Ohio. Primary findings were these:

- Continued inventory minimization. Competitive supply chains run on the least possible inventory, and those that already maintain low levels continually look for ways to cut it further. The consequence is that delivery service requirements are very high, and sensitivity to disruption substantial.
- Growing concern for supply chain risk. Low inventories mean no buffers, and breakdowns spread rapidly through the supply chain. Weather events, infrastructure failures, and lack of recovery options affect performance, and in turn affect facility location decisions.
- Continued reconsideration of networks. Supply chain networks are not optimized and changes of design and location are ongoing. Distribution facilities are regionalizing, sourcing and production locations are shifting.
- Dependency on trucking. Trucking captures two-thirds of supply chain expenditures, first because of its quality of service, flexibility and responsiveness, and second because supplier locations favor it.
- Necessity of air freight. This is a corollary to low inventory policy. Air is not the go-to mode for most products and supply chains try to minimize it. Instead, it serves as the fail-safe system.
- Rail intermodal growth. Mode shifts in favor of rail intermodal are increasing if not prevalent, because of improving quality and accessibility of service, and favorable costs. Automotive companies who have traditionally avoided it are giving it more although modest consideration.

- Quality of Ohio location. The availability of suppliers within an overnight drive of facilities, good and less congested roadways, its multimodal options, and its skilled labor force make Ohio a favorable place to be – but these are qualities that must be maintained.
- Dependency on Ohio two-lane network. Automotive manufacturers report that many plants and suppliers are not located on interstates. Interstates are critical, but the 2-lane network is a primary system, and its conditions are vital.

- Utility of intelligent information systems (ITS) for logistics management. Companies actively manage their supply networks and look for events that affect it. Real time information fed directly into their management systems can make this process more effective.
- Significance of truck driver shortage. This is not a typical state concern, but companies stress that the lack of qualified truck drivers is worsening, costs them money, and puts their operations at risk.
- Emergence of the natural gas market as an alternative to diesel fuel. The lower cost of natural gas, along with growth in production and eventually in distribution, make this a trend companies are watching and Ohio equipment manufacturers can capitalize upon.

1.2 Ohio's Freight System

Ohio is a crossroads state with a mature, intermodal transportation system. Some elements of the freight system are aging and in need of investment, there is overcapacity of some modes, and significant new investments in intermodal rail hubs. The sections below provide a profile of the major freight modes in Ohio.

1.2.1 Rail

The Ohio freight rail network is a mature system consisting of the major North American carriers (CSX, NS, and CN), as well as significant regional carriers and short line railroads. Ohio was a bellwether for national rail trends, as Class I railroads abandoned significant miles of rail lines in the 1970s and 1980s, or sold some unprofitable branch lines to short line carriers.

Even though Ohio has regrettably lost thousands of rail miles over the years, the system is carrying record amounts of tonnage on less infrastructure. In terms of financial health and infrastructure, Ohio rail infrastructure is in very good condition, with adequate investment, efficient switching terminals, good operating speeds, and significant investments in new intermodal facilities (detailed in a later section). In support of doublestack container operations, CSX and NS have investment a significant amount of private and public funds to raise tunnels and bridges to increase intermodal container train productivity.

In terms of infrastructure conditions, Ohio rail carriers operate over a "legacy" system that was largely designed in the late 1800s, with significant urban development and road growth since. Thus, rail lines through central business districts are often constrained by capacity, curvature and grade crossings with other railroads, for example in Cincinnati (Mill Creek Valley); Toledo (Vickers Crossing); and Columbus (Scioto Tower) to name a few. It is usually quite cost-prohibitive to eliminate these chokepoints. Beyond the large rail companies, short line carriers vary in their capital structure and ability to maintain a system of good repair, which results in some deficient short line railroads. Also, smaller railroads have a more difficult time upgrading their rail and bridges to accommodate 286,000 pound railcars, which can impact the viability of their operations.

1.2.2 Maritime

Through the Great Lakes and the Ohio River, Ohio has access to two of the nation's largest inland waterway systems as well as the Gulf of Mexico and the North Atlantic Ocean. Great Lakes traffic is dominated by bulk cargo shipment, with some international trade of general cargo (primarily steel) via

the St. Lawrence Seaway. The state is home to eight ports on Lake Erie. Three ports (Toledo, Cleveland, and Ashtabula) stand out in terms of their capabilities and cargo volume, while the others moved considerably less in recent years. The Port of Toledo, including seven miles on the Maumee River supports a large general cargo dock and terminals that handle grain, coal, petroleum products and iron ore. The Port of Cleveland includes general cargo facilities and terminals for limestone, gravel, salt, cement, iron ore, and petroleum products. The Port of Ashtabula includes the outer harbor and 1.7 miles of the Ashtabula River, a general cargo facility, and an NS Railroad terminal for coal, limestone, and iron ore. It has by far the greatest storage capacity for bulk commodities in Ohio. Ports in Sandusky, Huron, Lorain, Fairport Harbor, and Conneaut operate at different levels of facility development but primarily handle only bulk shipments of coal, limestone, iron ore, cement, stone, and salt.

On the Ohio River, commercial navigation is made possible through a series of lock and dam facilities that raise and lower barges on this corridor that connects Cairo, Illinois, to Pittsburgh, Pennsylvania. These facilities are maintained by the US Army Corps of Engineers (USACOE). Slow speeds and low supply chain visibility limit the viability of this mode to bulk commodities such as coal, iron ore, and stone, or agricultural staples. Barge terminals are clustered in three principal regions along the Ohio River: Cincinnati, Portsmouth-Marietta, and the West Virginia Panhandle. Like Lake Erie ports, Ohio River terminals predominantly handle bulk cargo like coal, aggregate, iron ore and chemical products. Some Ohio terminals do have the capability to handle general cargo such as steel products, and the river is very important for handling shipments of very large products such as industrial machinery.

1.2.3 Highways

The Ohio Department of Transportation is responsible for ownership and maintenance of 49,000 miles of paved roadway and 15,000 bridges . Freight is carried over these rights-of-way by trucks in private fleets, for-hire truckload, less-than-truckload , and other specialized trucking services. The trucking mode is the most vital part of the state's freight system, handling 97 percent of Ohio's freight value (federal statistics, 2007). Trucks dominate freight carriage because they can reach every shipper and be flexible in terms of shipment size and schedule.

Trucks make up about 13 percent of the traffic on the state highway system (all state, US, and Interstate Routes) and 18 percent of traffic on the subset of Ohio's Interstate Highways. Average daily truck traffic on Ohio Interstate Routes is about 10,500, and approached 15,000 on the heaviest truck routes: I-75 and I-70. Five-axle, semi tractor trailers comprise 80 percent of the truck traffic on rural interstate highways, while urban truck traffic has a higher percentage of two and three axle vehicles like panel and dump trucks.

Ohio is significant as a "crossroads" state. Fully 34 percent of Ohio truck traffic is "overhead," passing non-stop through the state. Another 41 percent of Ohio truck traffic is "internal," originating and terminating in the state. The Ohio Turnpike (I-80/90) exemplifies an overhead truck route, with 69 percent of truck trips originating and terminating outside the state.

1.2.4 Air Cargo

Ohio was once home to the most air cargo hubs of any state in the nation, but drastic changes in the industry has caused all but one to close (DHL is still in operation at the Cincinnati-Northern Kentucky Airport). The air cargo business has shifted in three significant ways: (1) more shipments shifted to trucks due to cost; (2) more air cargo is carried in the belly of passenger aircraft; and (3) FedEx and UPS emerged as a near duopoly in expedited parcel shipments (with their primary hubs in Memphis and Louisville, respectively). Consequently air cargo hubs in Dayton, Wilmington and Toledo have closed, and the Rickenbacker Airport was never able to retain an air cargo carrier hub.

The Ohio Freight Study evaluated the capacity and condition of air freight facilities at Wilmington, Toledo, Rickenbacker (Columbus), and Cincinnati-Northern Kentucky Airports. All these facilities are in relatively good condition, with Wilmington and Cincinnati-Northern Kentucky facilities virtually new. In lieu of attracting new air cargo hubs which is increasingly unlikely, the major investment needs for these air cargo operations will be conversion to new uses.

Although air hub operations may not be likely for these airports, there is still potential for substantial logistics operations, and with that potential, a need to improve connecting road networks. This is certainly the case at Rickenbacker, where the state and local governments are funding a major road connector; recent improvements have been made at Cincinnati-Northern Kentucky; and similar road improvements may be necessary to support the conversion of air hub operations in Toledo.

1.2.5 Intermodal Container Facilities

The major Ohio infrastructure development in the past 10 years has been the upswing in volume and investment in railroad container intermodal facilities. Ohio hosts 15 intermodal facilities in nine metropolitan areas, second only to Illinois in the number of facilities statewide. Rail carriers, with the assistance of some public subsidies, have invested heavily in creating terminals bridging the modal capabilities of roadways, rail, and marine cargo. NS Railroad, with assistance from public grants, invested heavily in the Rickenbacker Intermodal facility and doublestack clearance projects from Chicago, through Ohio to Norfolk, Virginia.

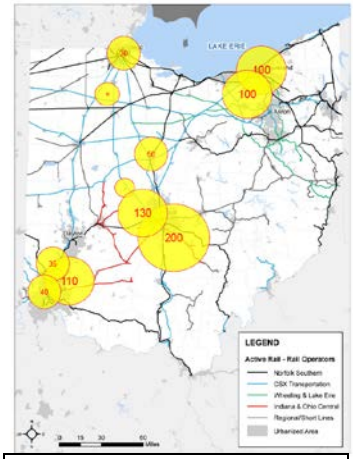


Exhibit 2: Active Rail Corridors

The Northwest Ohio Integrated Logistics Center in North Baltimore opened in 2011 serves the CSX network and is operationally focused on bypassing Chicago to distribute intermodal freight east of the Mississippi via a hub and spoke arrangement. CSX is also currently expanding the Buckeye Yard in Columbus to double operating capacity to 300,000 containers per year.

In addition to Rickenbacker and North Baltimore investments, railroads and private interests have also made significant investments in intermodal facilities in Marion (CSX), Columbus-Buckeye Yard (CSX), and Toledo (NS). The location of Ohio's intermodal facilities is advantageous because of the Ohio market, the good condition of Ohio's road system, and the proximity to the national market. While

intermodal growth over the past 20 years was primarily driven by international trade (specifically imports), development of new intermodal facilities and railroad operating and marketing practices has increased the viability of all-domestic intermodal moves.

1.3 Economic Trends and Freight Flows

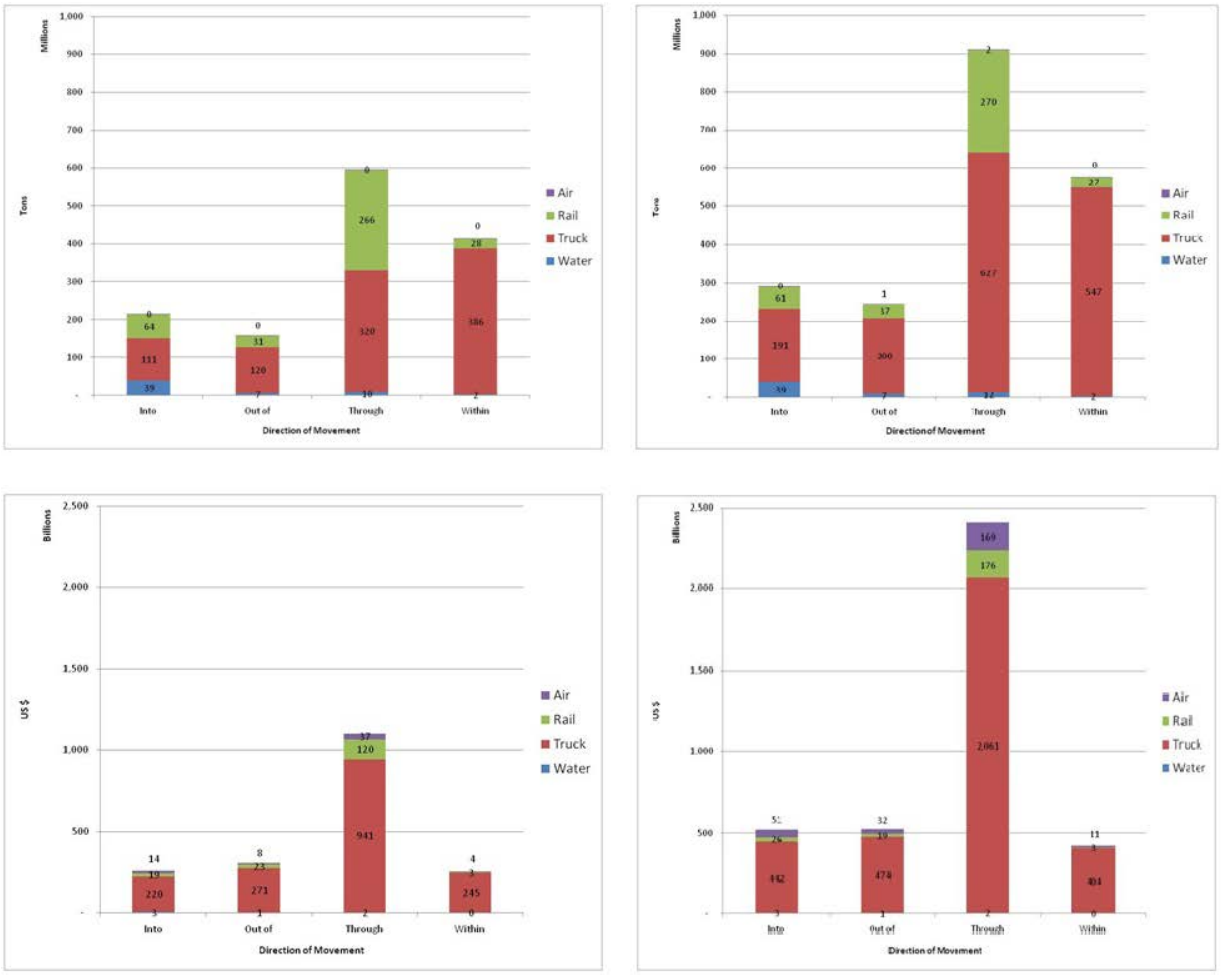
While total freight volumes are expected to escalate from 1.4 billion tons in 2007 to 2.0 billion tons in 2040, the modes will not be affected equally, and demands for capacity creation will put stress on Ohio's network of Interstates and other roadways.

- Base year modal split for all freight by tonnage: trucking at 68 percent, rail at 28 percent, water at 4 percent, and air cargo totaling .1 percent (which has since declined precipitously)
- Trucking moved 93 percent of intra-state tonnage and 97 percent of intra-state value in 2007
- Top trucking commodities by weight were base metals (8 percent), gravel (8 percent), and non-metal mineral products (6 percent) in 2007
- By 2040, gravel will rank first (9 percent), with waste/scrap (7 percent) and other foodstuffs (7 percent) having displaced base-metals and non-mineral products by 2040
- Through tonnage was 596 million (43 percent), intrastate 415 million (30 percent), inbound 215 million (16 percent), and outbound 158 million (11 percent) in 2007

Multimodal freight flow profiles drawn from the FHWA's Freight Analysis Framework 3 (FAF3) database appear in graphs below. They are summarized by type, tonnage, product value, and mode for freight traveling on Ohio road, rail, water, and aviation assets, with annual volumes for 2007 and 2040 forecasts extrapolated from the 2007 base year. Evaluations of tonnage relate to the physical demand on facilities, while measures of freight value gauge relationship to the economy. Traffic types distinguish shipments outbound and inbound from and to Ohio, internal within the state, and shipments traveling through Ohio between origins and destinations outside. Modal activity differs markedly by traffic type. In the 2007 base year, 93 percent of intra-state (Ohio-to-Ohio) tonnage was carried by truck, along with 97 percent of intra-state value. The 158 million outbound tons in 2007 were 76 percent truck (120 million tons), 20 percent rail (31 million tons), 4 percent water (7 million tons). Air accounted for a tenth of a percent for tonnage, but was more significant by value. For 2007 inbound flows, rail was stronger at 30 percent (64 million tons), with truck carrying 52 percent (111 million tons) and water 18 percent (39 million).

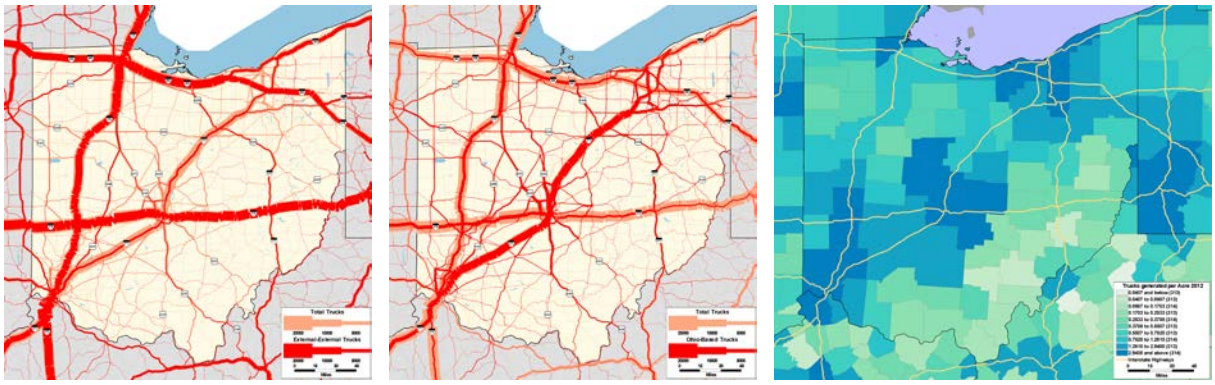
Of the additional 639 million annual tons forecast for all modes by 2040, 314 million annual tons (52 percent) are expected to be 'through' traffic, while 48 percent will be Ohio-based. Trucking is projected to carry almost all of it: an additional 628 million tons (98 percent of all incremental tonnage to 2040). Additional trucked tonnage will be evenly split between Ohio-based and 'through' traffic. For rail, FAF predicts a modest gain of 6 million tons (less than one percent of all incremental tonnage), with two thirds of it being 'through' traffic. For commodity gains in trucking, most of the marginal tons are increasing volumes of gravel (66 million tons, 11 percent of trucking's gain), waste and scrap (49 million, 8 percent), and 'other food' (45 million, or 7 percent). These FAF3 forecasts do not take into account recent changes in the transportation market spurred by energy resource development.

Exhibit 3: Summary of Modal Split by Annual Volume (top) and Annual Value (below), 2007 (left column) and 2040 (right column)



By tonnage, through traffic was the largest single contributor to freight capacity demand in 2007, claiming 43 percent (596 million tons) of this volume that year. By 2040, outbound volumes are expected to increase in share to 12 percent of tonnage moved annually, claiming 245 million. Through tonnage will increase to 45 percent of tonnage moved that year (910 million), while inbound and intrastate totals decline slightly in approaching 2040, according to FAF3 estimates that predate the development of the Marcellus and Utica shale plays. Differences in traffic type correspond to divergent usage of the highway freight system in Ohio.

Exhibit 4: Through vs. Ohio-based Truck Volumes, 2012 Annual



As the left and middle images indicate, through traffic and state-related flows adhere to distinct patterns in traversing the road network. The image at left compares total truck flows to through flows (those beginning and ending externally to Ohio) in 2012. The external travel generally favors interstates and other large capacity routes, most notably the east-west corridors of I-70 and the Ohio Turnpike – with I-75 prominent too, but not I-71. Alternately, the middle image compares the total to 'Ohio-based' truck trips, those being shipments that originate and/or terminate inside the state. Two characteristics stand out for the state-based shipping: first is that I-75 remains important but I-71 is now the backbone, crossing between the major cities of Cincinnati, Columbus, and Cleveland; and second is that the state's two-lane network emerges as a primary system. In 2007, state truck volumes totaled 937 million tons. Of that traffic, Ohio-based shipping accounted for 617 million tons or nearly two-thirds of the total, with the remaining third borne by through shipping.

County origins for truck shipping appear in the image at right. The primary urban centers and surrounding areas of the I-71 corridor are visible as the top generators for trucking, tracing a diagonal axis southwest to northeast. The north-south axis of I-75 appears as well, in the urban regions around Cincinnati, Dayton and Toledo. The function of the two-lane network in penetrating to industry located throughout this territory can be seen by comparing the roadways and county activity of the middle and right-hand maps. The state is responsible for all freight within its borders and all traffic makes demands on infrastructure. Nevertheless, Ohio-based freight serves Ohio commerce and population, and efforts to support that aspect of transportation will focus on distinct portions of the system.

1.4 Future Needs

Freight forecasts place the weight of future requirements on the roadway system, but multimodal service is one of Ohio's key strengths. While this section follows the focus on roadways, it examines emerging freight needs across the board.

- Roadway needs come from pressures of growth and the requirement for end-to-end service
- Facilities serving Ohio-based and through traffic are both affected, but Ohio-based needs are more pervasive because of the dependence on the two-lane network

- Immediate roadway needs are freight bottleneck solutions in urban areas, and route redundancy coupled with ITS-based management on the two-lane system
- Longer term, two-lane capacity expansions should be expected
- Rail bottlenecks are present, but solutions mostly fall to the private sector
- Rail needs are arising in the shale oil territory in Southeast Ohio, and systematic implementation of 286K track capability remains desirable
- Dredging for Lake Erie ports and lock and dam upgrades on the Ohio River are the main requirements on a waterway system that otherwise has adequate capacity
- Because of market shifts, air cargo requirements are mostly limited to efficient facility access

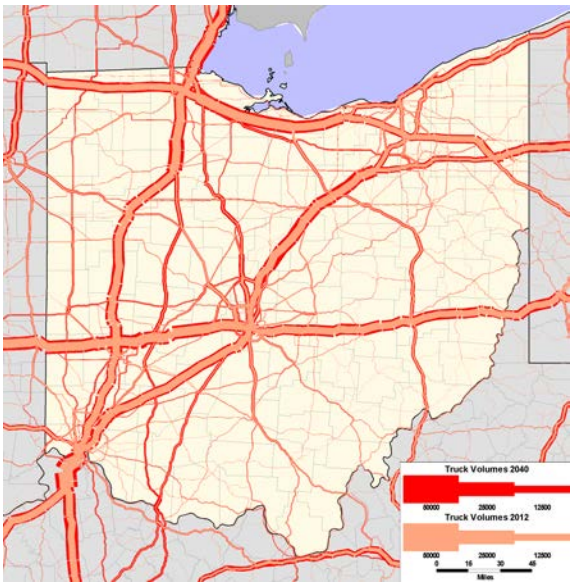


Exhibit 5: Total Truck Flows 2012-2040

1.4.1 Problem Areas

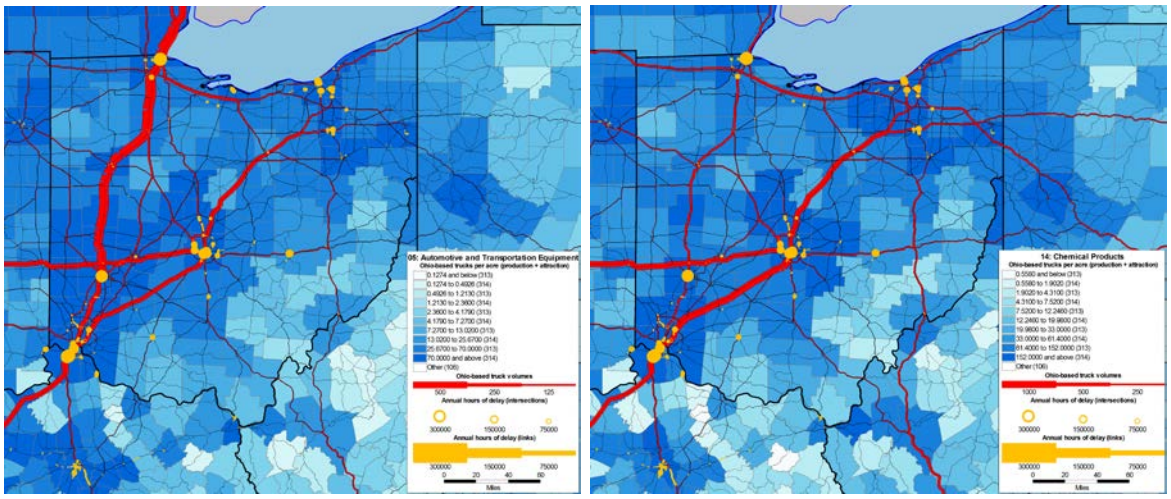
A strong freight network is crucial to retaining and attracting businesses and jobs, because network performance shapes the logistics performance that Ohio business uses to compete. There are two pillars to competitive performance. The first is fast, reliable, productive freight service for which the risks of disruption are managed, and the pressures of growth on the network are addressed. The location of those pressures appear on the accompanying map as dark colored 2040 total truck volumes surrounding the lighter colored volumes of today. The evident pattern is that pressure will pervade the system, with heavy growth from both through and Ohio-based traffic, and capacity needs will be broad-based.

The second pillar is freight service end to end, from pick-up at the shipper's door to delivery at the receiver's door, because the premise of a freight shipment is that the buyer receives the goods. It is no more satisfactory or effective for a network to perform well part of the way but not all of the way, than for an on-line purchase to be delivered thirty miles distant instead of to someone's home: the job isn't finished and no one is happy. This means that the Ohio two-lane network that connects to its towns and businesses, and the urban networks that cut through to industrial parks and commercial zones, are as much a part of competitive freight performance as the interstates. Moreover, this is the part of the system that mainly provides service to the Ohio-based traffic.

The pair of maps below illustrates the challenges for the Ohio-based freight system. For automotive and chemical products - two industries targeted for development by Jobs Ohio – the maps show the amount of truck shipping picked up and delivered by county, the roadway volumes for Ohio-based shipping, and freight bottlenecks on the roadways. Three things stand out. First, the industries rely on different sections of the network, implying that support to these industries will require attention to different parts of the system. Second, both industries make extensive use of the two-lane road

network, allowing them to ship from and serve customers in counties throughout much of the state. Third, the freight bottlenecks delaying service today are chiefly in the urban areas surrounding the I-71 and I-75 corridors. The implications for performance needs are a) that the urban networks require most of the immediate improvements (and projects at some bottlenecks are underway), and b) that service assurance on the two-lane system is more about intermittent disruption than chronic delay. The immediate two-lane solutions are route alternatives and ITS information systems for roadway and logistics management. Nevertheless, as the effects of forecast growth and successful development take hold, the few bottlenecks on the two-lane network promise to proliferate. Longer term, there will be capacity needs on the system outside the cities.

Exhibit 6: OH-based Automotive & Chemical Traffic by Truck (2012) with Highway Bottlenecks



Other needs affecting truck performance range from rest areas to support productive compliance with tightened safety regulations, to shortages of qualified drivers, to fueling stations to exploit the growth in natural gas alternatives to diesel. Rail system needs include a series of choke points mainly on the Class I railways, which fall to the private sector owners to address. Intermodal traffic should continue to expand, especially on corridors where railroads have been making investments; this affords modest highway relief but creates rising demand on roads accessing intermodal facilities. Completion of track upgrade to the 286,000 pound industry weight standard is an important need on the short line networks that feed the larger system, so that Ohio rail operates in a seamless fashion statewide. Development of shale petroleum production in southeast Ohio poses an increasing challenge and rail opportunity. Railroads are well suited to handle the great volumes of heavy bulk materials required for drilling, and have been successful in carrying raw product from other shale formations. However, the southeast part of the state lacks the rail corridor density that assures service, and has a high proportion of inactive rail lines (as illustrated here). Facilitation of private development of

Exhibit 7: Inactive Rail Lines

new rail services can help this Ohio industry to grow, with less new demand on local roads.

Marine facilities on Lake Erie are presently overbuilt, and operating under capacity. Even so, maintenance of clear navigational channels through dredging - and the associated disposal of dredge material – is essential for ports to function. Dredging on the lakes is a federal responsibility for which funding is chronically undersupplied, and even the highest volume facilities have unmet needs. On the Ohio River, its terminals are mostly single user, with no capacity problems or growth impediments for markets where they are competitive. The challenge is on the river itself, whose capacity is capped by the slow operation and size limitations of an aging lock and dam infrastructure. There are nine structures on the Ohio-adjacent section of the river alone, while the federal Inland Waterways Trust Fund allows improvements to just two or three per year anywhere in the nation. With the stress placed by drought on Mississippi River channels, Ohio River needs may be kept waiting.

The problems facing the air cargo industry are largely economic and industry-wide. The top air freight carriers continue to replace airplanes with high service truck networks wherever possible. Regional air hubs are consolidating in larger markets like Chicago and Detroit, with Ohio facilities facing reduced demand. The state's more active cargo airports in Cincinnati and Columbus mainly face challenges from rising roadway congestion, affecting the truck feeder services that connect air cargo to customers on the ground. On-airport facility conditions are adequate, with decreased parking availability the greatest concern.

1.5 Thematic Strategies

In the array of freight system needs, the broad outlines of responsive strategies are apparent. Several major themes offer focus points around which detailed strategies can be developed.

- Roadway freight performance is the greatest challenge, but it should be separated into programs addressing the distinct requirements of through and Ohio-based freight
- Mitigation of the burden of new truck volume is helpful; expansion of the Turnpike's higher capacity trucks to connecting or other through routes would be one way forward
- The two-lane network requires investment and management as a primary system, first with ITS and route alternatives, and ultimately with capacity increases linked to growth from target development industries
- Urban networks are part of performance delivery. Coordinated statewide and metropolitan programs make sense, especially as metro areas expand
- Promotion of natural gas fueling stations can help truck fleets convert to Ohio energy sources, and reduce the air quality detriments from truck traffic growth
- Rail can absorb more growth, through 286K standardization, accommodation of private intermodal service expansion, and support to shale country development
- Federal waterway fund constraints imply that water development priorities should reflect the best payoffs in freight service
- Air requirements are limited but air service is essential to supply chain operations; preservation is important but support to private efforts may be adequate and economic